The Welding Engineer

Edited by L. B. Mackenzie

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AIRCO DAVIS APPARATUS

ANYTHING AND EVERYTHING
FOR OXYACETYLENE WELDING AND CUTTING

Public faith in a product is a reflection of faithful performance. Thus, consistently, have Airco Oxygen and Airco Acetylene built up good-will.

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Some day you'll need this man

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This man has had years of experience and training in oxy-acetylene welding and cutting. He is ready to advise you on any troublesome job. He will help you train your operators, point out new methods, and increase your efficiency. He will inspect your Oxweld apparatus and supervise minor repairs.

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If you are not a user of Oxweld equipment, send for our illustrated booklet, "Oxweld Can Do It," or better still, telephone or write the nearest Oxweld Resident Engineer.

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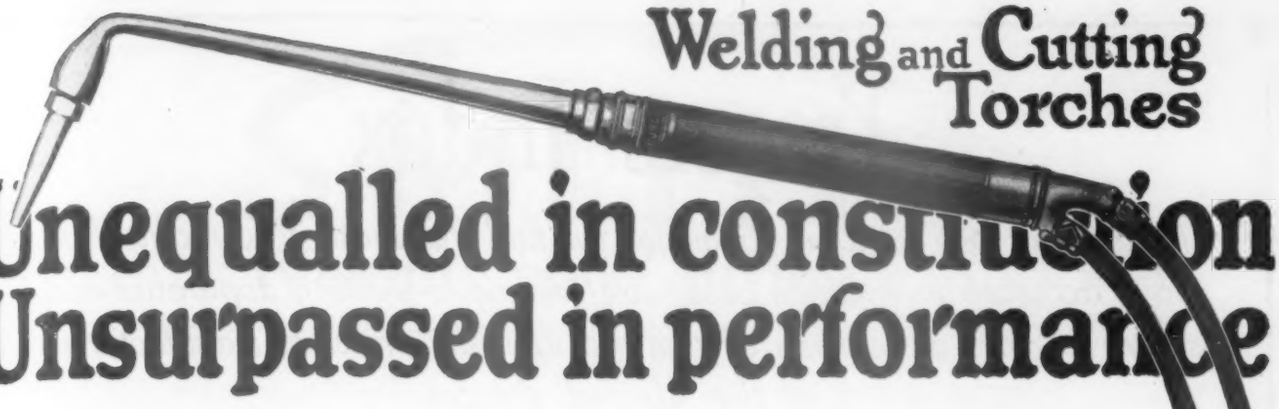
Oxweld

WELDING AND CUTTING APPARATUS

WORLD'S LARGEST MANUFACTURERS OF WELDING AND CUTTING EQUIPMENT

Welding and Cutting Torches

Unequalled in construction
Unsurpassed in performance



Flash Back

A "FLASH-BACK" is the establishment of a stable flame within the mixing chamber of a torch due to the striking back of the flame into the orifice of the tip.

A "BACK-FIRE" differs from a flash-back in that the flame does not continue within the interior of the torch but is extinguished and the mixed gas again issues from the tip in the normal manner and is reignited by the hot metal.

An oxy-acetylene flame is propagated in the open at a rate of several hundred feet per second. In a confined space this value may rise to several thousand feet per second.

The normal flame will not enter the orifice of a properly designed tip against the flow of gas. However, the flow of gas may be retarded by touching the tip of the metal or sparks may enter the orifice of the tip and start a high velocity flame or detonation.

It is impossible, or at least impractical, to provide a velocity of gas flow that will force out a high velocity flame. Therefore it is not possible to prevent back-fires.

The ease with which a torch will back-fire depends upon the design and workmanship on the tip and the gas velocity.

Purox torches are not easily back-fired and they accomplish this result through tip design rather than resorting to a hard flame.

The mixer and mixing chamber are proportioned so that the pressure developed in the event of a back-fire is used to control the flow of oxygen and acetylene in such a way that the flame is extinguished.

Purox torches withstand extremely severe abuse without a flash-back and when operated with ordinary skill Purox torches are entirely free from the resultant loss of time and annoyance.

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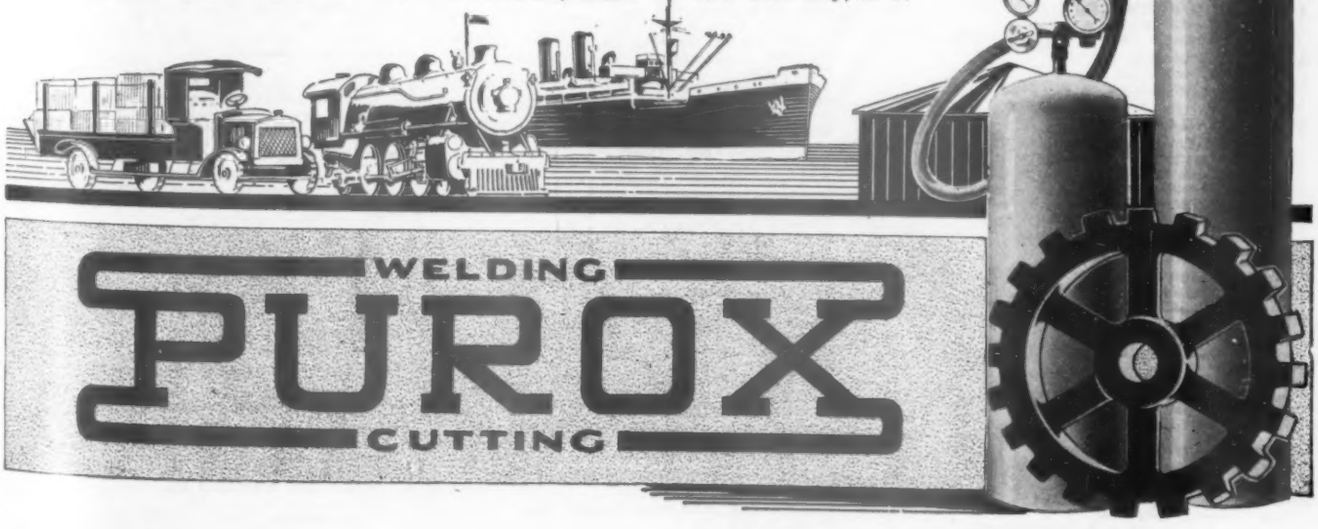

WELDING
PUROX
CUTTING

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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Air Reduction Sales Co.
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Purox Co.
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Welding Metals Mfg. Co.

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Purox Co.
Sall Mountain Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Welding Metals Mfg. Co.

BLOW TORCHES (Acetylene)
See "Torches"

BOOKS (Relating to Welding)
The Welding Engineer
Electric Arc Cutting & Welding Co.

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We not only do welding, but supervise the design and installation of oxy-acetylene welding plants; report on welding material and methods; make tests on welding apparatus for efficiency and economy.

Nine years' experience.

Rochester Welding Works
349 Orchard St., Rochester, N.Y

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Purox Co.
Smith's Inventions, Inc.
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U. S. Welding Co.
Electric Arc Cutting & Welding Co.

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See "Torches"

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Wm. Cramp & Sons
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Electric Arc Welding & Cutting Co.
International Oxygen Co.
Modern Engineering Co.
Mutual Auto Spec., Inc.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
Purox Co.
Imperial Brass Mfg. Co.
Page Steel & Wire Co.
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Wilson Welder & Metals Co.

SMITH'S

Quality Welding and Cutting Equipment

Smith's Welding Equipment is built with the idea that service, and not first cost, is the criterion of merit. Economy and ease of operation, safety and durability are vital factors if your welding equipment is to return real profits on the investment. Thousands of dyed-in-the-wool boosters for Smith's Welding Equipment are proof that the Smith Idea of "Service First" is right.

Smith's Portable Preheating Torch

Up-to-date shops are discarding old makeshift methods of preheating in favor of the New Smith Portable Preheating Torch. This torch is a self contained unit, not dependent on a compressor for air. The torch takes raw kerosene from the container, passes it through a retort coil in the bowl, forming a kerosene gas which burns with intense heat. Consumes about 1½ gal. of kerosene per hour on full blast.

Torch comes complete with tank, 18 ft. special kerosene hose and adjustable stand. Ready to set up on the job.

This Smith Portable Preheating Torch is ideal in shops not equipped with compressed air, and in shops where heat must be taken to the job. Proper manipulation of the shutter in the back of bowl gives a constant even heat, regardless of surrounding temperature. The flame will not vary or surge—it gives heat, when, where and in any amount wanted.

Smith Automatic Acetylene Generators

Smith Automatic Acetylene Generators assure their users of a dependable and economical supply of pure acetylene gas. They are simple and strong in construction and last for years without appreciable signs of wear. Acetylene gas generated in Smith generators costs not over 1¼c per cubic foot—an enormous saving over gas in tanks. Made in sizes from 20 to 200 lb. carbide capacity.

The portable Type Generator illustrated is particularly adapted to field work, or moving from job to job in the shop. They are constructed on the principle of the well-known non-spillable ink bottle, simple and strong, with a positive carbide locking device. Made in 20, 30 and 50 lb. sizes.

30 lb. **Smith Portable Automatic Acetylene Generator. Equipped with handles for easy moving, or can be mounted on special truck. A really portable, practical and desirable generator.**

Smith Welding Torches

Smith Welding Torches are sturdy and well-balanced, built to give the operator a constant, soft neutral flame that will not burn, carbonize or blow the metal being welded. Each tip assembly has its own mixing nozzle, located away from the heat of the flame and not affected by expansion of the tip end. The Smith line includes torches and tip assemblies for every possible use. These and other profit making items are fully described in our new catalog No. 5.

Smith's No. 6 Welding Torches

The welder's best bet. Smith quality throughout. Comes regularly equipped with five tip assemblies, 9 inch extension, canvas carrying case and torch wrench. Cutting tip assembly No. 24 screws into handle of No. 6 torch same as ordinary welding tip assembly. Forms a light well-balanced cutting torch that will economically cut material up to 8 in. thickness.

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Gibb Instrument Co.
Quasi-Arc Weldtrode Co.
Seneca Arc Welder Co.
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International Oxygen Co.

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Chicago Steel & Wire Co.
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Purox Co.
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International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
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Purox Co.
Page Steel & Wire Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.

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Bierman-Everett Fdy. Co.
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Central Steel & Wire Co.
Universal Oxygen Co.
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Davis-Bournonville Co
International Oxygen Co.
The Imperial Brass Mfg. Co.
Modern Engineering Co.
Purox Co.
Oxweld Acetylene Co.
Reid-Avery Co.
Torchweld Equipment Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.

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Bierman-Everett Foundry Co.
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Imperial Brass Mfg. Co.
Modern Engineering Co.
Mutual Auto Spec., Inc.
Purox Co.
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Welding Metals Mfg. Co.

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General Electric Co.

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Air Reduction Sales Co.
Davis-Bournonville Co.
Purox Co.
Superior Oxy-Acetylene Machine Co.

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Davis-Bournonville Co.
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International Oxygen Co.
Imperial Brass Mfg. Co.
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Welding Metals Mfg. Co.

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Purox Co.
Quasi-Arc Weldtrode Co.
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Bastian-Blessing Co.
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Purox Co.
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Gas Products Association
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Imperial Brass Mfg. Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
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Harris Calorific Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
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Smith Heylandt Co.
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Purox Co.
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Welding Metals Mfg. Co.
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Carbic Mfg. Co.
Davis-Bournonville Co.
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

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The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Metals Welding Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Purox Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

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International Oxygen Co.
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Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
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Superior Oxy-Acetylene Machine Co.
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Torchweld Equipment Co.
United States Welding Co.
Welding Metals Mfg. Co.

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Purox Co.
Smith's Inventions, Inc.
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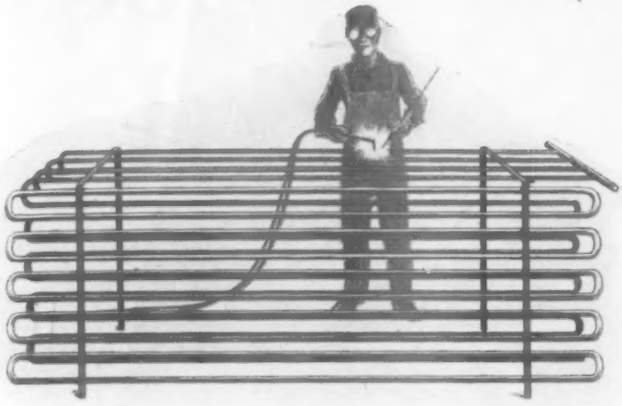

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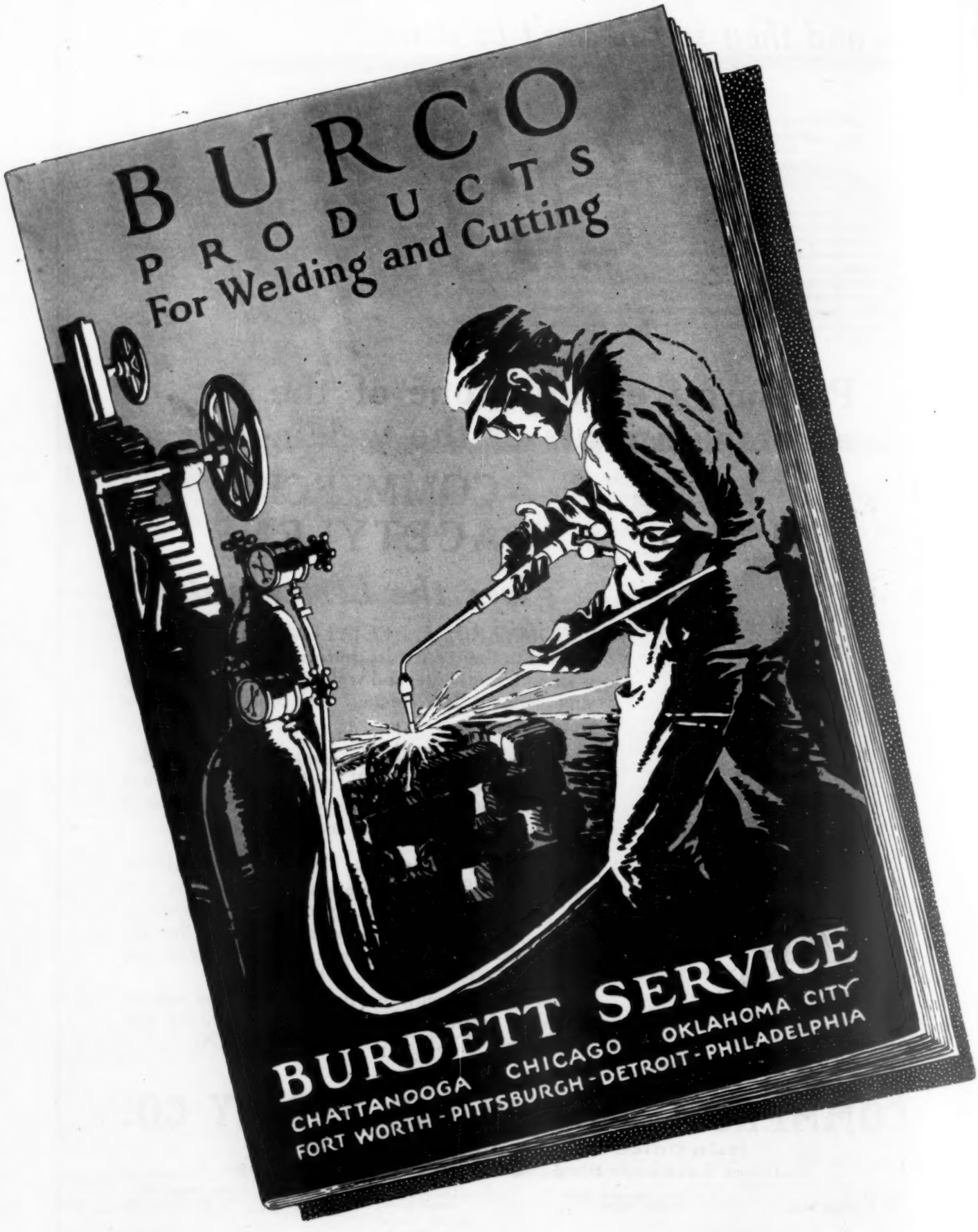
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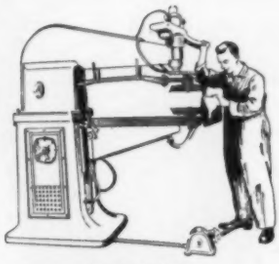

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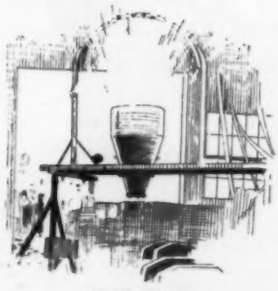

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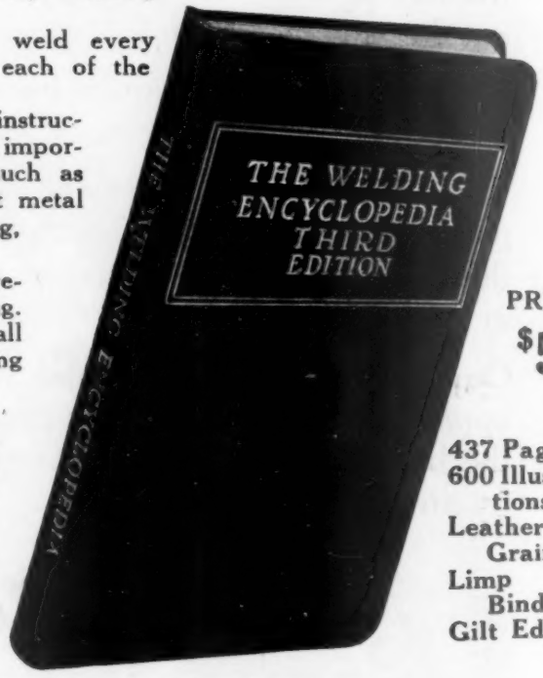

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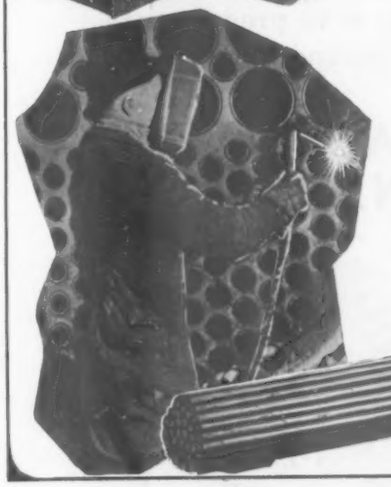

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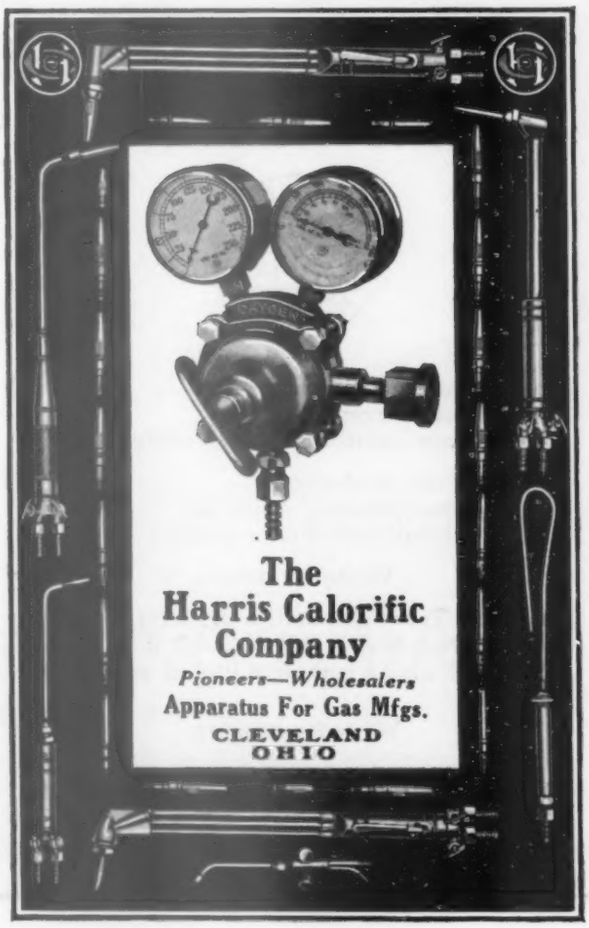

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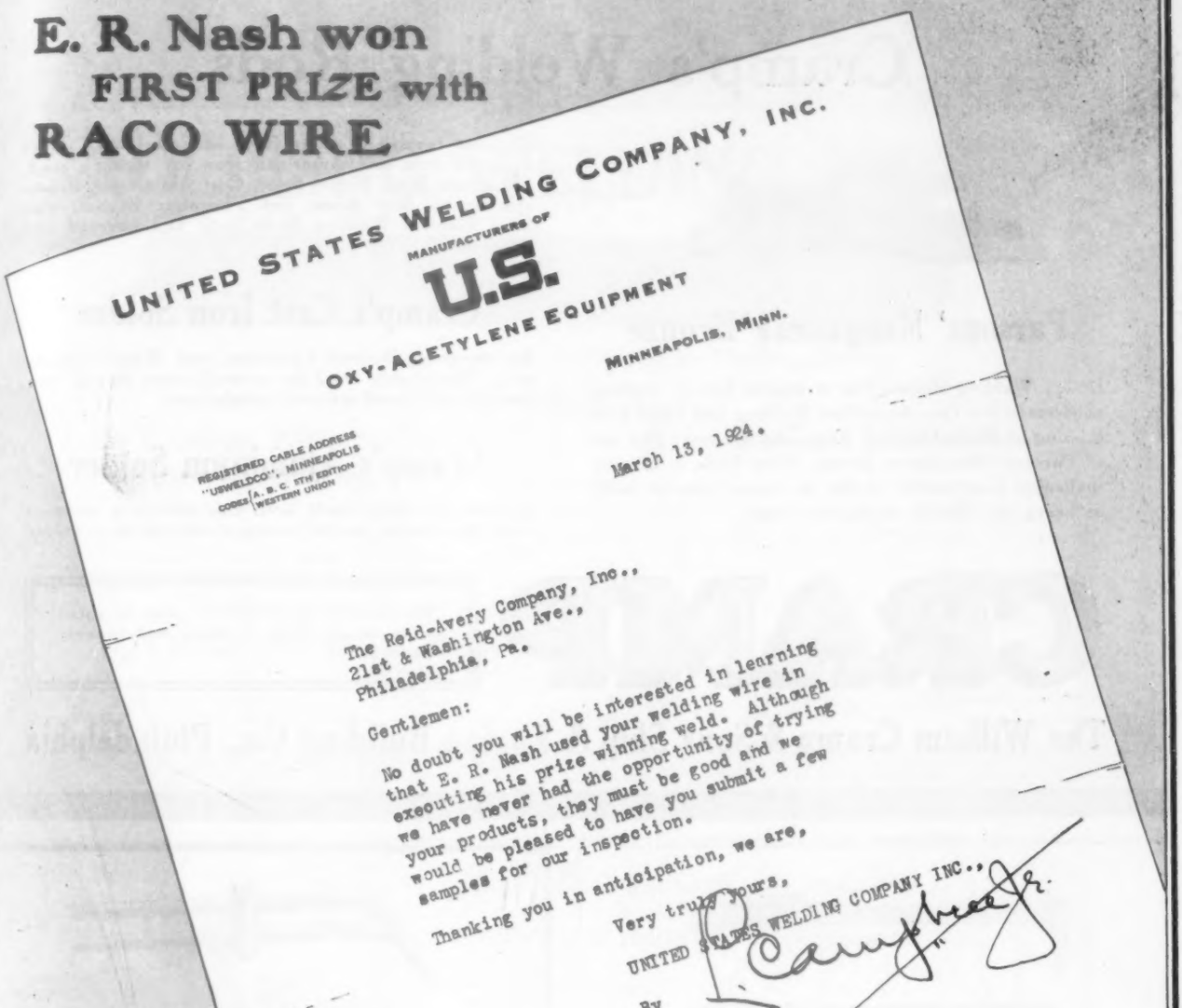

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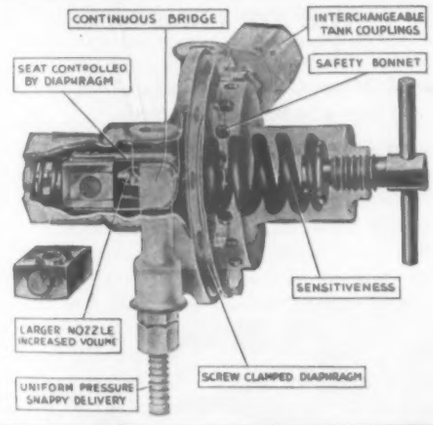

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This is one of a number of books which have been compiled and printed by Linde as a part of Linde service. They are free to Linde users.

Any Linde user may secure a copy of "Cast Iron Welding by the Oxy-Acetylene Process," or information regarding all Linde books from the nearest Linde District Sales Office.

Watch this column for announcements regarding Linde books.

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PRODUCTION BRAZING

How Brazed Joints Are Made in Ferrous and Non-Ferrous Metals—Jigs Help to Speed Production

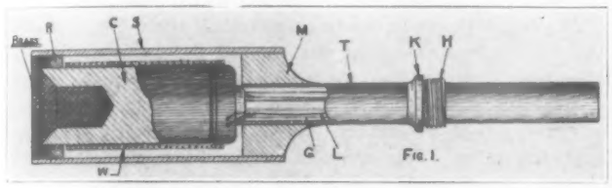
By B. Heyman

PART II

IN PART I of this article was given a general discussion of the underlying principles. In this paper will be taken up several applications which have been made, showing how an unusual manufacturing problem was solved, and a very successful commodity produced. And this, in a cheaper manner than would have followed, had a standard design and ordinary manufacturing methods been used.

The particular product is a high grade electric soldering iron which is being sold to the trade on the basis of being an all-brazed article, hermetically sealed by brazing methods, and without a mechanical joint in its construction.

It will probably be of interest to note that when the original designs were produced and the question of brazing certain parts taken up with experts, the latter decided that it would be impracticable to use such a method. It caused unusual comment,



Construction of Electric Soldering Iron.

however, when a successful method was developed and samples of the finished work exhibited. In fact, even now the problem, as outlined, of brazing the final elements would cause consternation if propounded to the average brazer or welder. It is true that the ordinary methods of performing the work would hardly suffice. Unusual methods are required, but it is just that which has made for success.

Originally, all of the brazing was performed by means of air and acetylene torches of the type in which the acetylene aspirates sufficient air into the mixing chamber, where the combustible and air are thoroughly mixed. Of late this practice has been changed and the air-acetylene torches are used on certain parts of the work as will be explained in this article. Oxygen and acetylene are also used in one of the modern types of blowpipes, but on a type of work which will be detailed at another time. By this means it has been assured the manufacturer that he receives his product in the best possible condition and in an efficient manner. Production speeds have been made a maximum consistent with all of the controlling conditions and many of the defects ordinarily attributed to the method have been entirely eliminated.

Remarkable as it may appear, the inspection on this product is so rigid that that the slightest defect in the machined surfaces of the brass causes the rejection of the article to the scrap heap or to the class of material known as "seconds" and used only on replacements or repair orders.

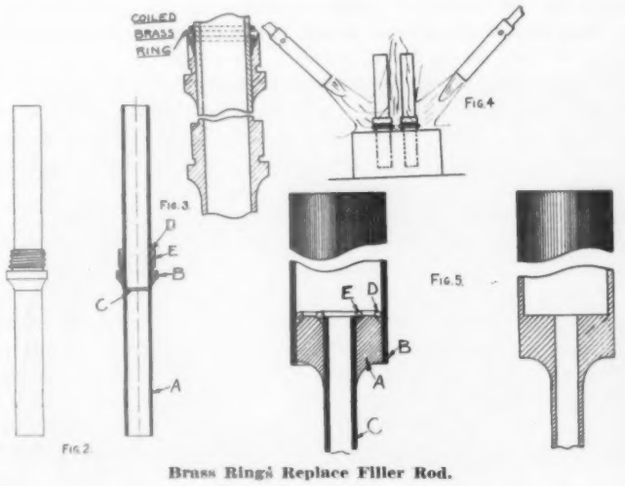
Inasmuch as the tool is an electrical instrument which is raised to a high degree of heat through the agency of an internal winding of very high resistance, this winding must be sealed and protected from the air. Otherwise combustion occurs and in a very short time the winding has been destroyed. For this reason every precaution is taken to eliminate from the product any work that appears to have even the appearance of a faulty joint. Careful supervision keeps the work up to a high standard. It is a rare occasion to have defects appear after the iron has been sold and used.

And this is in itself extraordinary when it is appreciated that the tool is being alternately heated and cooled—also roughly abused. Expansion and contraction strains are continually acting upon every joint, producing in one member an excessive compression and in the other a tremendous tension, without failure occurring. So great is the pressure exerted on the various members that it is no rarity to find that the outer steel shell has been contracted and has extruded the internal brass section without rupturing the joint.

In order to better appreciate the construction of the tool, and before describing the brazing operations, it would be well to examine the fabrication of the assembly from the various details.

Fig. 1 is a cross section (diagrammatic) showing the assembly of the various items which constitute the iron. Briefly, T is a drawn seamless seal tube upon which is pressed the steel collar K. The collar is brazed in place and then machined to form the threads H which match a ferrule in the wooden handle that is attached to the iron previous to shipment. The stem T is then pressed into the middle ring M previously assembled in the shell S and this assembly brazed so that a perfect joint is produced between the shell and middle ring and between the middle ring and stem. The brazed surfaces are machined smooth and the shell S expanded at its outer end to take the sub-assembly consisting of the steel ring R upon the heavy copper core C. The latter also carries a complicated winding and mica insulation W. The most difficult brazing operation then occurs, namely filling the space thus formed (indicated by the heavy shading) with brass, which is then machined to form a seating surface and a thread to take the copper tip.

In all of these operations one important rule, must be observed,

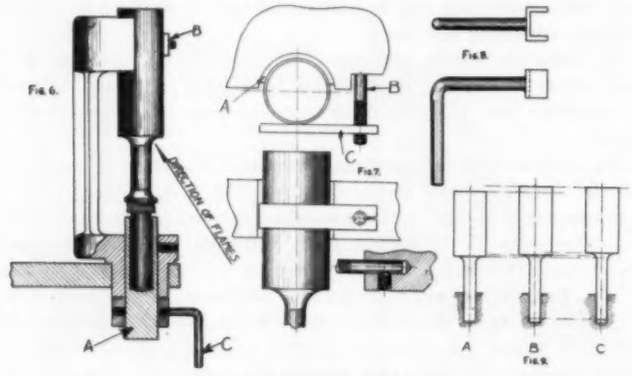


Brass Rings Replace Filler Rod.

and that is that "cleanliness is next to godliness." After each machining operation, preparatory to the brazing, the parts are washed in boiling lye, rinsed in hot water, and thoroughly dried to remove every trace of oil and grease. The area which is to be brazed is then polished with rough emery to remove rust or scale which may have formed, and immediately brazed. Every precaution is taken to protect the parts from possible accumulations of dirt or the formation of oxide which may affect the efficiency of the joint. Burrs which may have been formed by tooling are carefully removed by reaming operations permitting free access into the joint for the molten brass and the fluxing agent.

Before the final brazing work is performed, (the copper core into the case) every portion of the exposed surface is carefully scraped with proper tools, and the scrapings all removed. Although by frequent trial it has been demonstrated that perfect work can be turned out without this unusual precaution, still it has been found that time and again a slight defect will appear in the finished product due to a slight oxide formation on the copper which did not react to the flux action and the stirring process which is used.

In brazing the stem collar and also the assembly of shell, middle ring, and stem a soft brazing wire of high zinc content is used in which a sufficient allowance has been made for whatever volatilization may occur. This wire is coiled on a mandrel and then slit into single rings which fit in positions for brazing, so that when melted the fluid will run into the joint. The winding



Jigs Used for Production Brazing.

is performed by hand on a speed lathe and the slitting is done by means of a circular saw, the coil being gripped in a special fixture on a milling machine.

The wire diameter and size of ring has been determined by experiment and is such that with the standard set-up it will melt at such time as the steel surfaces have attained the correct brazing temperature, forming the bond with a minimum loss of brass through oxidation and with a maximum penetration into the joint, thus forming a very efficient bond.

Mention has been made of fluxes. On all steel to steel joints ordinary 20 Mule Team Borax is used. On the copper to steel joint one of the patented mixtures is used, prepared by one of the well known flux manufacturing concerns. Most likely, almost any standard flux would suffice for the purpose, but it has been found that unusually fine results have been obtained with this compound and it is usually the best policy in a case of this sort to leave "well enough alone" regardless of a difference in cost of a few cents per pound, unless a definite improvement can be obtained by making the changes.

Preparatory to actual brazing, a standard set-up is made of torches and product in similar fashion pursued on automatic machines of any kind. As the tool is made in a number of sizes and capacities no two of which are alike, the conditions must be changed requiring for each a different set-up. Charted pressures are used and samples brazed. These are carefully inspected for flaws. Cross-sectional cuts are made, filed, and polished and the joints very closely examined. If satisfactory, these are given an O. K. and the work allowed to continue.

Careful records are made of any unusual conditions that exist and remarks set down for future reference and consideration. It has been found that previous experiences when properly analyzed have lead to unusual developments and perfection in the methods used. Cylinder serial numbers, pressures, room temperatures, etc. are noted, as these are all found to be of importance, particularly where a certain lot of material happens to cause trouble.

Fig. 2 shows the initial brazing operation one of the simplest types possible, and yet one, the application of which to this work, has made possible a very fine product, light in weight, and inexpensive to produce. A is a seamless steel tube of light gauge upon which is pressed the machined steel collar B. This piece is crimped at the lower edge C, so that it becomes fixed in position on the stem. By means of a positive stop on the press the location of B on A is made definite for all pieces. The two members, as one, are then prepared with flux and brass and brazed by filling the groove D. Then the surface E is machined to form the thread shown in Fig. 2.

The operation of brazing and preparing the stems is synchronized so that there is no lost time while a lot is being finished. A small quantity of 20 Mule Team Borax is sifted into the groove and a coiled brass ring of the proper size forced over the stem and into the groove as shown in Fig. 3. When molten the groove is nearly filled and the combination of ring and stem is equivalent to the conditions shown in the lower drawing Fig. 3.

The brazing is performed by inserting the stems in a heavy cast iron block as shown in Fig. 4. Four stems are brazed at one time the torches being set so that the flames converge at a central point between all four and then distribute in such fashion that all of the stems receive the same amount of heat.

About a dozen or more stems are prepared and set in a suitable rack. The torches being lit, the stems are inserted in the block, one at a time, by means of long flexible tongs which grip the upper edge. The operation generally begins at an even minute on a clock and is allowed to run exactly 2 minutes. In the meantime more stems are loaded with flux and brass rings. When the time limit has elapsed the stems are removed in the same order as inserted, with the exception that for every one removed a new one is inserted immediately. The brazed stems are placed in metallic pans situated directly underneath the brazing table. This produces the condition which gives each stem the same brazing time and is absolutely continuous insofar as the operator continues to prepare his stems and inserts them at the proper time.

Actually the operation is very simple. Since air and acetylene is used the flames are very soft and there is no tendency for the steel to oxidize. A slight volatilization of the zinc in the brass occurs but the fumes can be carried off by exhaust fans and by a properly designed hood.

As there are 4 pieces being completed during each 2 minute interval the actual time per piece becomes one-half minute which permits for large production in a short space of time. The operation is inexpensive and produces a much cheaper and lighter piece than could be made from solid material.

These stems are then machined as has been mentioned and after thorough cleaning to remove oil, scale, burrs, etc., are ready to be assembled for the next brazing operation.

In Fig. 5 the steel middle ring A is pressed into the shell B and into the center of A is pressed the stem C, as prepared in the previous brazing operation. A small quantity of borax is distributed over the top of the part A and the brass rings D and E inserted by dropping into the case. These are then melted to form the finished case shown in the right hand view Fig. 5.

Fig. 6 shows the fixture used for brazing the cases and is self-explanatory, excepting that the handle C is used for oscillating the fixture and B is the specially designed holding device which is detailed in Fig. 7. The stem of the case rests in the cylindrical sleeve A which also acts as the movable bushing in case of height adjustments.

In Fig. 7 the part marked A is cut from a hollow cylinder and is held in the body of the fixture by a flat-head countersunk screw. This makes for flexibility, permitting an interchange of bushings for different sizes of work. B is a coarse stud upon which is held the clamp arm C. which is manipulated by means of the tool shown in Fig. 8. After the fixture has once been used under the flame it becomes very hot and by means of this tool and an ordinary pair of gas pliers the work can be inserted or removed.

As the drawings Fig. 5 and 6 clearly indicate the brass is melted inside the case under the action of exterior flames, the

direction of which is shown by the arrow. The brass and flux flows into the points and makes a perfect union. Careful adjustment is required to prevent too large a flow of the molten material from the extreme bottom of the case.

It follows from the nature and method of the work that the flames must be very soft and their intensity so graduated that the heat will be soaked into all of the sections very gradually. In fact it is a very similar case to that of preheating a complicated motor block consisting of an intricate pattern of varying thicknesses of metal. If too much heat is applied at any one point there is apt to be a local volatilization of the zinc in the brass or if the flame is too close to some section that section becomes overheated and the remaining portion of the work is not heated enough.

For these reasons the set-up is made very carefully by measurement in conjunction with such common-sense applications of the experiences as have been amassed from previous production work. But this does not always give the very same results and minor charges are often required in order to compensate for variations. However, once the torches are so placed that the resultant product is as required, the work is turned out in consistently satisfactory fashion.

One of the very interesting features of this problem is that of linear expansion and contraction. It will be noted that the lower end of the stem is fixed in position by the end of the hole in the bushing A, see Fig. 6. As the flame is played on the case, ring, and stem, there is a rapid increase in length which finally becomes fixed and remains so until the fixture is swung out of the flames and the piece begins to cool. This linear expansion is handled by the piece sliding between the bushing and clamp. The adjustment of the clamp must be made so that it does not grip the case too tightly and yet it must hold it so that the case is retained in any vertical position. Naturally when contraction occurs the case is held by the clamp and the stem is pulled away from its original position so that finally the can remains suspended.

Fig. 8 shows this diagrammatically. In A the case has been set

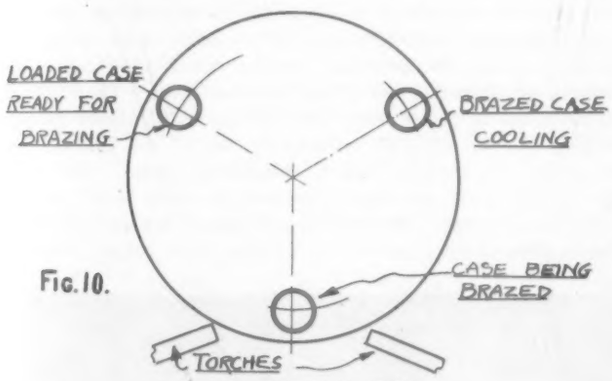


Fig. 10.

Diagram of Rotating Table.

in its normal position. In B expansion has occurred and is shown exaggerated. In C contraction has occurred and the case has become its normal length and is suspended.

Much depends upon the adjustment of the fixture in this operation. If the clamping arrangement is too tight, when expansion begins the stem forces its way into the middle ring and this produces a shortened product when contraction occurs. On the other hand, if the clamp is too loose the expansion will occur as required but at the point of maximum increase in diameter the case may slip down over the ring and also shorten the piece.

Several fixtures (Fig. 6) are used on a rotating table with two fixed torches, an indexing device bringing each fixture into the correct position relative to the flames. By this means a piece is in the flames while another one is cooling, ready to be removed for the insertion of a new one. See Fig. 10.

The loading and brazing operations are carried on simultaneously, loaded material being placed in suitable racks conveniently placed and as the former is very rapidly performed the operator can watch the brazing very carefully. Actual conditions as they occur within the case are observed by means of a mirror set at the proper angle a short distance above the case. By this means possible defects are eliminated such as partial melting of the brass or the tendency of the rings to slip into a vertical position under the frothing action of the borax.

Standard time intervals are set for the work, although a small allowance of time is permitted in either direction in case the brass melts too rapidly or too slowly. This is easily discernible by means of the heavy greenish zinc vapor which is passed off at the proper point.

A chart similar to the following one is used for all work for setting up and as a permanent record in guiding the operator on future work.

Case Brazing

Size	*Acetylene Pressure*	*Time in mins.*	*Rings*	*Borax*
100	3	1½	2-E-11	1 meas.
200	3	2	1-E-11 1-E-21	1 meas.
300	4	2½	1-E-17 1-E-31	1½ meas.
400	4	3	1-E-17 1-E-41	2 meas.
500	3	2	1-E-11 1-E-51	1½ meas.
600	1½	1	3-E-65	Slight
700	3	2	2-E-11	1 meas.
800	5	4	1-E-17 2-E-81	2 meas.

These are purely symbolic and refer to part numbers.

(To be continued)

KANSAS CITY ORGANIZES FOR BETTER WELDING

Through the combined efforts of Mr. W. A. Slack of the Torchweld Equipment Company, and Mr. W. J. Thomas, and Mr. C. W. Rambo, of the Kansas City Branch of The Purox Company, a meeting was held on April 1st at the branch office of The Purox Company, with the object of forming a Kansas City Section of the American Welding Society. The

Organization Meeting of Kansas City Welders.

new organization was given the name of the American Welding Society and Purox Welders' Club.

The following temporary officers were elected:

Chairman—Mr. A. M. Griffin.

Vice-Chairman—Mr. F. W. Luff.

Chairman of Relations Committee—Mr. W. J. Thomas.

Secretary-Treasurer—Mr. W. D. Klein.

About sixty men were present at this organization meeting, and the interest displayed indicates that future meetings will be well attended, and that the work in that section will make consistent progress.

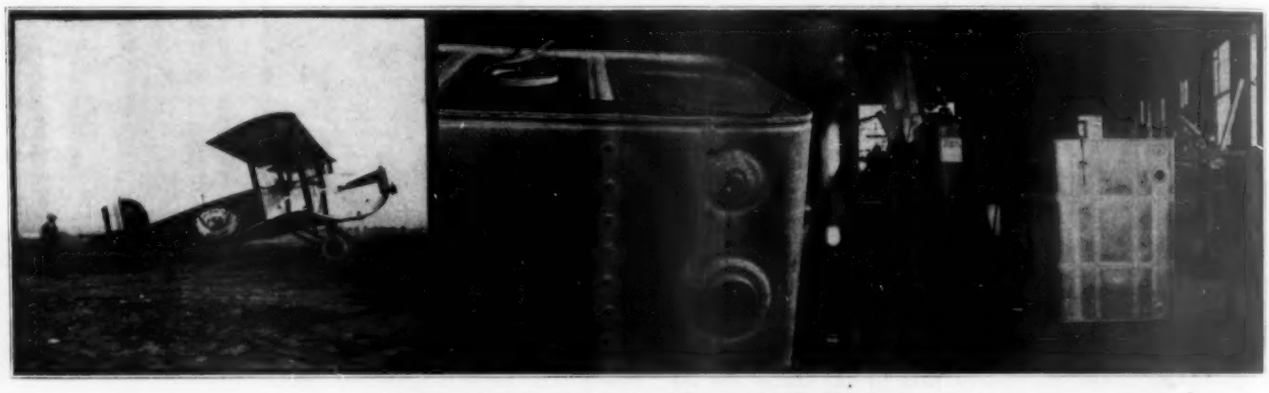
WELDING WORLD HISTORY*

Leakproof Tanks and Solid Joints Are Features in the Construction of the "Round the World" Planes

THE most dramatic undertaking since Magellan's famous voyage around the world in 1521, and a far more thrilling one, is that of the United States Army Air Service, whose four 'round-the-world cruisers, under command of Major F. L. Martin, hopped off at Santa Monica, California, March 19, 1924, on their epoch making flight.

Whatever the result may be, the mere attempt of these intrepid United States Army flyers thrills the world with interest and admiration and reflects upon the nation both honor and glory.

Apart from the very interesting human side of this American exploit, there is a romantic mechanical story involved in it which every machinist, metal worker, and manufacturer will be interested in hearing, for no machines ever faced a more grilling ordeal than that which confronts these super-ships, nor were any ever better mechanically prepared to meet it.



Major Martin's Plane and Two Views of the Welded Tanks

The four planes were built under government supervision by the Douglas Company of Santa Monica, having been designed by Mr. Donald W. Douglas, who is recognized as one of America's foremost aeroplane designers. They are designed as land or water type planes for long distance flying, and readily convertible to either type by the interchangeable features of land or water type landing gear.

The fuselage is made in three detachable sections, and is constructed of steel tubing. Wings are of standard wood box beam and built-in rib construction. The wings may be folded back for convenience in storage. The water-type landing gear consists of twin pontoons of built-in wood construction, the top covering being of three-ply veneer, and the bottom planking being two plies of mahogany.

The specifications of the World Cruiser are as follows: Weight, empty as a seaplane, 5,500 pounds; disposable load, 2,615 lbs; gross weight, 8,000 pounds; as a landplane, weight, empty, 4,300 lbs., disposable load, 2,615 lbs. gross weight, 6,915 lbs. Gasoline capacity, 450 gallons, enough for an eighteen-hour non-stop flight. Wing span, both upper and lower, 50 feet; height, 13 feet 7 in.; length, 35 ft. 6 in. Engine, 400 horsepower Liberty engine, capable of turning the propellor 1,750 revolutions per minute at high speed. As a seaplane, with its maximum weight and load totalling 8,000 lbs., the World Cruiser is capable of reaching an altitude of 7,000 feet; will travel 100 miles an per hour, and can be safely landed at 53 miles per hour. As a land plane the World Cruiser with its maximum weight and load totalling 6,900 lbs. is capable of reaching an altitude of 10,000 feet; will travel 103 miles per hour and can be safely landed at 35 miles per hour.

All gauges and control instruments are in the front cockpit. In the rear cockpit, the mechanic's station, are a speed indicator, a compass, an altimeter, and a hand gasoline pump. The airplanes, however, can be flown from either cockpit. The three gasoline pumping systems are also installed in each of the Cruisers; engine-driven, wind-driven, and hand-operated pumps. Serving as seats in each plane are Kapok cushions, to serve as life preservers in an emergency. Strapped to each man is a parachute. Each man is allowed forty pounds of baggage, a .45 caliber automatic pistol, fishing tackle, and emergency rations for 48 hours. Ample first aid equipment and charts of all territory to be traversed also will be carried.

A Few of the Welded Joints in the "Round-the-World" Flyer.

The cruising radius of the planes as land ships is 1,800 miles; as sea planes 1,450 miles.

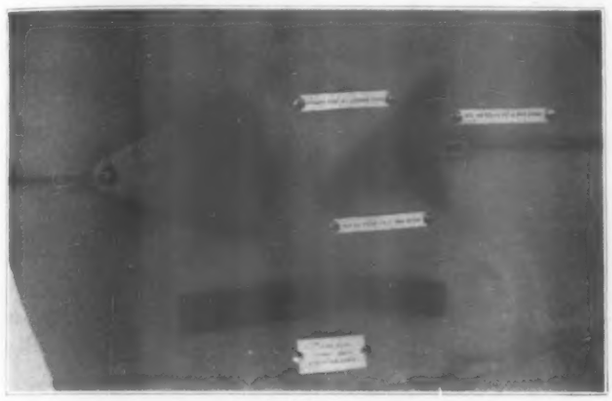
Tanks on the planes were constructed of sheet aluminum and the frame-work of steel tubing; the saving in weight of steel fuselage construction over wood being 27 pounds and the saving in cost thus effected 15%.

By courtesy of the Purox Company.

All material and workmanship were in strict accord with the high responsibility of the manufacturer and one of the most exacting tasks performed was the welding together of the various metal parts.

Proceeding upon the theory that a chain is no stronger than its weakest link and an airplane, likewise, no stronger than its weakest welded joint, the Douglas Company gave to the welding the most scrupulous attention; and how strong the welded joints are is clearly indicated in the photographs illustrating this article. Note, for example, the result of the test on the tubing welded with a V-shaped weld; how it broke straight across instead of pulling the weld apart or breaking in coformity to the shape of the weld; thus indicating that the weld was in fact stronger than the original tubing.

Because of the tremendous strains to which the parts of these



A Few Tests on the Welded Joints.

planes will be continually subjected on their trip around the world, the value of such welding can scarcely be over-estimated and, if the flight is successful, it will be no small part which the Douglas Company's welders played in welding world history.

To Major Martin and the seven army heroes associated with him in this hazardous adventure, the praise and the glory will rightfully belong when the flight is completed, but to the able designer and to his humble welders there has already come not only the appreciation of the industrial world but a priceless sense of satisfaction in the thought that they have done their bit in time of peace and have done it thoroughly and well.

PROFESSOR THOMSON SAILS FOR EUROPE

Professor Elihu Thomson, one of the founders of the General Electric Company, sailed April 26th on the Comte Verdi for a three months' tour of European countries. While abroad, he will receive the Lord Kelvin gold medal, which was recently awarded to him. The presentation will be made early in June at London, England. This award, made through joint action of British and American engineering societies, occurs every three years and is a mark of distinction for excellence in research work in engineering. Professor Thomson is the first American to receive the honor.

NEW SHEET METAL TORCH

A new type of torch, known as the "Sheet Metal Torch," has recently been brought out by The Alexander Milburn Co., Baltimore, Md.

It is a sturdy, compact torch possessed of characteristics giving it a high degree of efficiency, adaptability and convenience. It is light and convenient to handle on sheet metal and other light welding with the oxy-acetylene process. The torch works with low and comparatively equal pressures of oxygen and accetylene.

In this device, the manufacturers have devised a torch that is capable of being handled easily in corners, limited spaces, etc. This is due to the elimination of the head; the tip screwing onto a threaded, curved tube. This feature does away with the perplexing conditions that arise when a "tight" place occurs—for instance, welding in corners.

Because of the perfected design of the gas passages in the tip and mixing chamber, the makers claim that the danger of backfire or flashback is eliminated and that it is possible to push the tip into the molten metal and it will not flashback, it welds on just the same. The torch is adapted to any gas, either from generators or compressed gas in tanks.

The diameter of the handle and the balance of torch have been carefully considered. This means ease of handling in continual welding operations. This torch is of exceedingly simple construction, there being few parts, thereby reducing the necessity of repairs to a minimum.

The complete unit which sells for $55.00 consists of; 1 Sheet Metal Torch, 15 in. long; 3 tips for torch; 1 single gauge oxygen regulator; 1 single gauge acetylene regulator; 1 length of oxygen and 1 length acetylene hose, 3 ply, 12½ ft. long; beginner's supply of steel, cast iron and Tobin bronze rods and fluxes for same; 1 pair goggles; 1 pair leather gloves; 1 Pyro friction lighter; 1 set wrenches.

Each regulator is said to maintain a constant, predetermined pressure, regardless of fluctuation in the high pressure line and variations in consumption at the torch.

The seat of the regulator closes with the pressure. This permits closing by a sealing pressure of several pounds. The closing of the seat is independent of the diaphragm. As the seat is held in perfect alignment it works with accuracy for a long time. According to the manufacturers a perfect balance or equilibrium of pressure is maintained at all times in the regulator, throttling the supply when desired pressure is built up, and instantly responding with increased supply when consuming requirements lower the delivery pressure.

G. P. A. TO MEET AT ATLANTIC CITY

Atlantic City, New Jersey, has been selected by the Gas Products Association as the meeting place for the annual summer convention, which is to be held on June 10, 11 and 12. Plans are being made for a number of important business sessions for the discussion of problems pertaining to the manufacture and sale of oxygen, and also a number of entertainment features which promise to make the convention a thoroughly pleasant one.

One interesting feature that is being planned is "a deep sea fishing trip." It is proposed to take along a couple of tanks of oxygen in the hope that some of the fishermen will become sea sick, and give the manufacturers of oxygen an opportunity to experiment with the use of oxygen as a cure for that terrible disease. Reports of this experiment will be watched with great interest by all members of the oxygen producing industry.

OXYGEN FILM WINDS UP SPRING PROGRAM OF CHICAGO SECTION

The final spring meeting of the Chicago Section of the American Welding Society was held Friday evening, May 2nd. The program consisted of a new motion picture film, "Oxygen —The Wonder Worker," and a lecture on the Oxy-Acetylene Process, by Mr. Fred Maeurer, of the Air Reduction Sales Company. An added feature of the evening was the serving of coffee and sandwiches after the showing of the film.

STEEL SALES NOW HANDLING COLOR-TIPT METALS

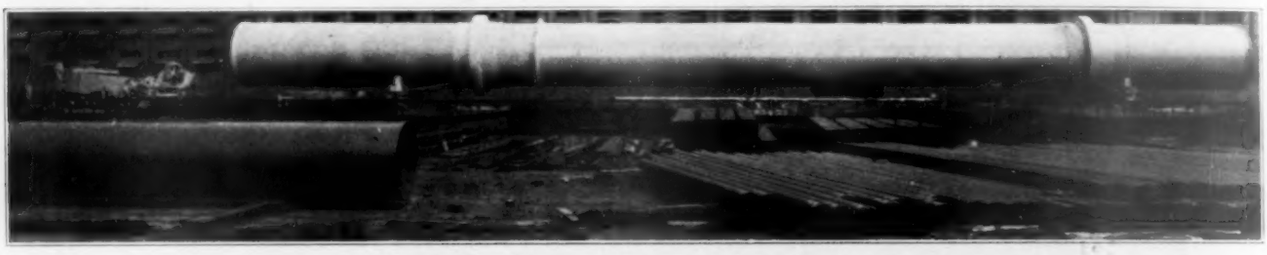
Announcement has been received of the appointment of the Steel Sales Corporation, 124 S. Jefferson Street, Chicago, as distributors for the "Color-tipt Welding Wires," manufactured by the Wilson Welder & Metals Company, New York City. The Steel Sales Corporation is now carrying a complete stock of these wires for welding steel, cast iron, monel metal, brass, bronze and aluminum.

GAS WELDED ROTARY KILN*

Procedure Followed in Welding 8 by 125 Foot Kilns—Seams Welded from One Side Only

By Raymond Orwig†

IN JANUARY of this year The Reeves Brothers Company of Alliance, Ohio, secured an order for three 8′ 0″ dia. x 125′ 0″ Rotary Kilns and three 5′ 0″ dia. x 50′ 0″ Coolers, to be installed at the plant of the Union Carbide Company at the Soo. On the placing of this order a request was made that consideration be given the possibilities of welding at least a part of this equipment by the oxy-acetylene process. Although the acetylene torch had been in use for some time in the plant of The Reeves Brothers Company, for both cutting and welding purposes, at no time had an operation of this magnitude been attempted and there was some doubt expressed as to whether the acetylene process would be adaptable to the building of Rotary Kilns, primarily for the reasons that equipment of this type must first be true to circle and second, true to alignment in order to meet requirements, the allowance in this case being within 5/8″ of true on both the feed and discharge end when rolled.

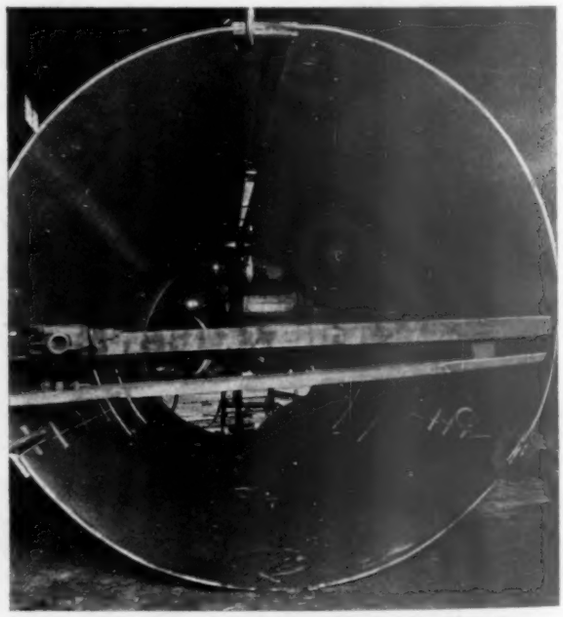


Huge Oxy-Acetylene Welded Rotary Carbide Kiln, 8 ft. in Diameter and 125 ft. Long.

After due consideration by the Engineering and Operating Departments of The Reeves Brothers Company, it was decided to ask our customer, together with representatives of the Linde Air Products Company to meet in Alliance for a conference to determine the possibilities of obtaining a creditable and satisfactory product by using the Acetylene Method in lieu of the riveter method as proven and used in the past.

At this conference the different types of plate layout or construction, the procedure to be adopted in fitting and welding, the welding equipment required and the probable cost, were discussed. It was decided to proceed with this object in view, to weld one of the 8′ x 125′ Kilns and the three 5′ x 50′ Coolers, with the exception of the supporting tire, driving gear and reinforcing band connection to the shell proper, which were to be riveted in the usual manner. It was also decided to keep as close to the general proven design for riveted equipment of the various sizes, as possible. To further eliminate the possibilities of partial failure and to develop ways and means for controlling the alignment of the kiln, and the best method of welding both the girth and longitudinal seams, it was decided to first construct an experimental section to be composed of three ring sections 8′ dia. x 8′ long, made up of one plate to the ring, the longitudinal seams to be staggered and when completed to give a section 8′ dia. x 24′ long, which, if entirely satisfactory, could be used in the adopted design for the 8′ x 125′ Kiln.

The shell of the Rotary Kiln was to be made up of 5/8″ plate throughout and the shell of the Coolers of 3/8″ plate throughout. We will first complete the experimental section. The edges of the plates on the experimental section were planned for a double V forming an angle of 90 degrees on all longitudinal seams and on all girth seams. The plates were then rolled to an 8′ diameter circle. The longitudinal seams were welded first. On the first section, the longitudinal seam was tacked about every 18 inches throughout the length of the 8′ 0″ and the outside of the seam welded first by one man starting at one end and welding straight through to the end of the seam. The section was then rolled over and the inside of this seam was welded by two men, starting at the center of the section and welding in opposite directions to the end of the seam. By this method it was found, that due to contraction, the edges of the shell were inclined to overlap and caused some distortion in the shell. This brought out the possibility of trouble to be encountered when connection of girth seams was made and so on the longitudinal seam of the second section, one end was tacked on the outside when the seam was closed and the seam spread about 1/4 inch to the foot, making the opening about 2 inches on the other end. Starting on the closed end, this seam was welded on the outside to the opposite end. The section was then rolled over and the inside weld made with two men as described for section No. 1b. This method showed marked



View Showing Clamps and Spacing of Longitudinal Seams.

*Paper read before the International Acetylene Association, at Chicago, Nov. 16, 1923.

†*Assistant Works Manager of the Reeves Brothers Co., Alliance, Ohio.*

improvement and although not perfect it was decided to proceed along this line, exercising every possible means to improve results. On the third section the same method was used with some slight improvement.

In connecting the first two sections to form the girth seam, the rings were tacked in about 8 to 10 places on the circumference and two welders started, one working on the top of the cylinder and on the outside weld, the other on the inside of the cylinder on the inside weld. The cylinder was then rolled as the welding proceeded. In this manner one-half the girth seam was originally welded on the inside, the other half on the outside. The cylinder was rolled to complete the circumference, the outside man finishing that part originally welded by the inside man and vice versa.

The second girth seam was welded in the same manner, however, at this time clamps were introduced to aid in alignment and also to keep about a ¼" space between the two units or halves of the V's. Considerable improvement was noted by using this method.

On the completion of the experimental section it was decided, that although this section was far from perfect, the original idea of welding one 8′ x 125′ Kiln and three 5′ x 50′ Coolers, would be carried out, with some changes in methods which had been brought out in welding the experimental section, the most marked of these being a change in the V's, it being decided that all longitudinal seams would be single V'ed from 100 degrees to 110 degrees angle and the method of spreading the seam be used and welded from th outside with a wash weld on the inside. In the case of girth seams the double V 90 degree angle would be continued but the clamp arrangement of fitting would be used and in addition a flat contact surface of 1/16" would be

Welded Longitudinal Seams.

planed to the edges of the V's to prevent the knife edge of the V's as used before, cutting through the clamps.

The experimental section had been welded by experts from The Linde Air Products Company's laboratories, and in that these men would not be available for future use, the problem of securing welders to replace them, presented itself.

Too much care cannot be exercised in the selection of welders especially in a case of this kind, where quality of weld is the essential item, and every precaution was taken to the end that men of steady habits were secured. These men were of various stages of experience and very rigid supervision was maintained, as well as a very thorough course of instruction given, every man making a number of test pieces which were sent to the laboratories for test and inspection, each man being made conversant with the findings. When the necessary proficiency had been gained, he was permitted to start work on the kiln itself, under close supervision, additional test pieces being made and tested from time to time during the course of the work.

The question of fatigue and relief does not enter into the majority of manufacturing problems of today, but in the case of welding this does not hold true. The ordinary man cannot weld for the standard day of eight or ten hours and produce quality welds, and with this in mind, two men were detailed to each torch throughout the operation, each man welding 50 per cent of the time with frequent relief. This could possibly be cut down somewhat, say detailing three men to two torches, thereby cutting the cost considerably, but in case this is done, very close and dependable supervision must be arranged for.

The plate layout and construction of the 8′ x 125′ kiln, starting at the feed end and working toward the discharge end, was two rings of 8′ section, one plate to the circumference, one ring of 30′ section made up of three 30′ plates arranged 3 plates to the circumference, 5 rings of 8′ section, one ring of 30′ section and one ring of 8′ section. The two 30′ sections were reinforced by one band 66" wide on

Welding Longitudinal Seam of Short Section.

each section, and making the complete circumference. The supporting tires were connected to the shell at these two points.

In preparing the material the plates were first laid out and planed to the proper size on the ends, to insure not only a true 8′ diameter, but also a true butting edge to form the longitudinal seams. On the long edges of the plates, which form the girth seams, the plates were squared up to mill size, which is usually slightly more than ordered size, thus giving some slight allowance in the over all length of the kiln to counteract possible contraction. The plates were then rolled to the proper radius and the edges set in slightly to counteract the tendency of the welding operation to pull the edges out of the true plane of the circle.

The longitudinal seams of the 8′ 0" sections were fitted up and tacked at one end and spread at the other end as described for the test section. These seams being single V'ed, were welded on the outside and wash welded on the inside of the seam at the same time, this work being done overhead. This method proved much more satisfactory than the first method used of welding a full weld both inside and outside, and proved a time saver. If proper supervision is given, as it was in this case, and welders capable of doing good efficient welding are employed, there should be no hesitancy in using this method on material of this thickness (⅝") where no pressure is to be applied. In fact, as the work proceeded, this wash welding was entirely eliminated and the longitudinal seams welded on the outside only. But this again brings up the important point of quality welding and being absolutely certain that the metal is properly fused to the bottom of the V.

The 5′ x 50′ coolers were made up of six rings about 8′ wide, one plate to the circumference, with a ¾" x 4" band on each end.

The three plates forming the 30′ sections of the kiln, were fitted up with the aid of clamps and bars punched to suit the holes for attachment to the tires. The first seam was then rolled to the top and the seam tacked at one end and spread

Another REGO Scoop

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1. A construction guaranteed against **flashback;**
2. Elimination of the objectionable and sometimes **dangerous** feature of **mixing in the handle;**
3. Elimination of the necessity of constant **change** of mixing chambers.
4. Wide range of tips that are **easily** interchanged;
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6. Real honest-to-goodness **nickel copper** heat-resisting tips **(not** copper **coated** brass);
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The REGO GL large gooseneck torch is the ideal torch for the big shop with a wide range of work. With its assortment of 3 extensions and 10 tips it will handle any welding from the heaviest preheated job down to light sheet metal work.

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REGO GL torch, only—13 in. long —no extensions or tips	$25.00
6 in. extension only—for tips 1, 2, 3 and 4	5.00
12 in. extension only—for tips 5, 6 and 7	7.50
24 in. extension only—for tips 8, 9 and 10	10.00
REGO GL tips, each	1.75
REGO GL torch, complete with 3 extensions and 10 tips	65.00

REGO GM Torch

A medium torch for work up to 1 in. on iron, steel, copper, bronze and aluminum. Just the torch for pipe welding, automotive repair and production, tank and other medium welding.

Length, 20 in., Weight 25 oz.

Price—GM torch, 6 tips and 6 in. extension	$27.50
Extra extension, 12 in. long for	7.50

REGO GS Torch

A small handy torch especially popular for light production work, such as the welding of milk cans, small tanks, kitchen utensils, fenders, electrical parts and all metal construction limited to 5/16 in.

Length 14 in., Weight 15 oz.

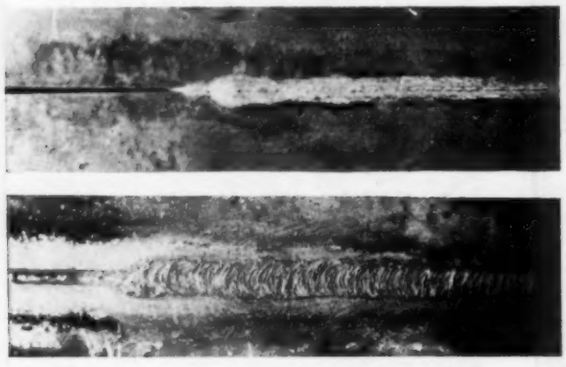
Price—GS torch with 5 tips	$20.00

The Bastian-Blessing Co.
246 E. Ontario St., Chicago, Ill.

about 8" at the other. The seam was then welded on the outside and wash welded on the inside as described for the 8' sections.

Some trouble was experienced in keeping the edges of the plate forming the seam, properly aligned, but by using a jack, worked just ahead of the welder, this was overcome. These seams were checked very carefully as the welding proceeded, so that the shrinkage of the spread could be controlled. Each of the three seams of the first section were welded in the same manner. However, on the second 30' section the wash welding was eliminated and this section welded in a similar manner to the 8" sections described before.

In welding the girth seams to connect the various sections, as mentioned before, all the seams were double V'ed. The sections were placed on a roller and clamped together. At first the seam was tacked in 8 places on the circumference, but on later sections this was changed to 6 tacks with better results, and on the last two or three sections this was changed



Above—Single Vee Weld from Inside
Below—Double Vee Weld Partly Completed.

to 4 tacks, one on each quarter, which proved more satisfactory than either of the other methods.

As described for the experimental section, the girth seams were welded by two men, one working outside and the other inside the cylinder being revolved to permit vertical welding at all times.

As each section was added, the completed part of the kiln, together with the new section fitted on, was rolled to check alignment and slight corrections made as the work proceeded, to insure a straight kiln and one that would roll true on completion. The over all length was checked at this time also to make allowance possible to correct any variations as the work progressed.

The reinforcing bands were then fitted on the kiln, each of them being made in two pieces forming a half circle. These bands were riveted to the shell as in regular riveted construction, but the abutting edges had been properly single V'ed and were welded, making one solid circle. The tires and gear were riveted to the shell as is usual in riveted construction. The same method as used for the reinforcing bands, was used in the case of the end bands.

The welding of the coolers, although a very interesting problem in itself, was rather overshadowed by the larger and more trying problem of securing a quality product in the kiln and it will suffice to say that the same methods were used with as good, and possibly a little better results, than in the case of the kiln, this being due to smaller diameter, shorter length, and lighter material. The quadrants running the length of the coolers were riveted.

The time and materials used, in the construction of the 8' x 125' kiln were oxygen, 28,280 cu. ft.; welding wire (¼"), 892 pounds (nickel steel); torch hours, 706; man hours, 1,352; size tip, No. 12.

The time and materials used on the three coolers were oxygen, 15,470 cu. ft.; welding wire (¼"), 330 pounds (nickel steel); torch hours, 257; man hours, 511½; size tip, No. 10.

As to the cost of a riveted kiln compared to the welded kiln the welded kiln cost 77 per cent more than kilns of the same size built by the riveted method.

The cost of the riveted coolers as compared to the welded coolers showed that the welded coolers cost 31 per cent more than coolers of the same size built by the riveted method.

In a general conclusion of the facts as given, it is apparent that every possible precautionary measure was taken and that methods of fitting and welding were changed frequently, all of which contributed to the abnormal cost of the completed product and would not be represented in a duplicate installation.

It is regrettable that a better cost cannot be submitted but when we consider that this operation was the first of its kind to be attempted and that quality of product was the primary aim, I do not feel that the cost is at all excessive and there is no doubt but what it could be cut considerably on a second kiln.

Mr. H. L. Noyes, of the Union Carbide Company, writes in part under date of October 30th: "We regret to advise you that the welded kiln is not yet in service, as we were greatly delayed on our foundation work. However, when I was there about the middle of October, it was mounted on the trunnions as were also the two riveted kilns and looked very well indeed. In fact, everyone who sees the kiln is well pleased with it.

This welded kiln had some severe strains during shipment and moving it to the foundations, but there is no distortion apparent.

We expect to have these kilns in operation about the middle of November and probably by the 1st of December we could advise you how it compares with the riveted kiln."

Oxy-acetylene welding is coming into more general use every day but it is still in its infancy and to predict its possibilities is rather a large undertaking, but from indications it is here to stay and to further its cause in the eyes of the trade, the users of the method must produce quality product first, and second must bring the cost to a competitive basis with other and older methods. I feel that this will eventually be done, especially on equipment requiring tightness, and the fact that the A. S. M. E. has recognized this method for pressure vessels up to ⅝" thickness of material, is the first step.

CONNECTICUT WELDERS GET TOGETHER

Recently the welders of Westchester and adjoining towns of Connecticut had quite a get together meeting and dinner, given by Mr. O. W. Adams, Mamaroneck, N. Y., distributor for the K-G Welding & Cutting Company. It developed during the course of the evening that the reason for the feeling of animosity existing between competitive welding shops has been caused by their not having had a chance to become acquainted and talk things over.

The results of this dinner were very satisfactory because it gave the welders a chance to become acquainted with one another and discuss plans whereby they could work in harmony. Many of those who attended this meeting are still wondering whether Mr. Steck of the Mt. Vernon Welding & Machine Company, has been able to get one of his favored taxicabs or not, and it is also said that Messrs. Hibbins of New Rochelle are still waiting for Mr. Spicer of the Mt. Vernon Company to drive them home.

It seems that every welder wanted to show his good feeling for the rest of the boys by furnishing transportation, and every salesman who was present began to think up nice things to say about his competitor's line. Little affairs of this kind go far toward promoting good feeling between the different members of the industry and building up a good name for the welding trade in general. It is not an easy thing to get them together, but the results are always good.

Some Chemical Aspects of Welding*

Chemical Changes Produce Great Differences in Properties and Composition—Principles of Oxidation and Reduction

By J. R. Booer

(*Continued from April issue*)

In both processes of welding the chief causes of oxidation are to be found, firstly, on the rod before it actually reaches the high temperature zone and secondly, on the work and the deposited metal immediately after the high temperature zone.

So far all the information points decisively to the fact that unless very special measures are taken to prevent it, oxidation is inevitable; and so having dealt in fairly full detail with the disease, let us turn to the consideration of the remedies.

Oxidation—Its Prevention.—It is hardly necessary to deal in any great detail with the necessity for preventing oxidation. Most welders are familiar with the entire lack of tensile strength and elongation possessed by metallic oxides. The heterogeneous nature of a weld containing oxide inclusions is also familiar.

The alteration in mechanical properties due to the oxidation of carbon in the welding of cast iron, is also familiar; in brief, oxidation represents all that is bad and undesirable for the welder.

The prevention of oxide formation is approached from two distinct directions, chemical and physical. The chemical method makes use of suitable reducing agents which decompose any oxide formed, and the physical or protective method, which firstly protects the welding rod, secondly protects the deposited metal, and thirdly dissolves any undecomposed oxide. The reducing agent may be added to a flux or be incorporated in the welding wire or rod, but in this latter case the use of a suitable flux is still essential, to prevent local oxidation.

Reduction.—Reducing Agents.—A large variety of reducing agents have been used with varying degrees of success. One of the least successful and yet one which is still in extensive use is carbon. The reducing action of carbon at the temperature of the welding operation is extremely small. This is partly accounted for by stability considerations, partly by the readiness with which carbon oxidizes in the atmosphere, and partly by the fact that it is carbon monoxide and not the element which actually brings about reduction. Added carbon is also inefficient in replacing carbon removed by oxidation, as for example in the welding of cast iron.

Silicon is not a reducing agent in the proper sense of the word. Reference has already been made to its reaction with carbon dioxide in the welding of cast iron. The properties of ferro-silicon are similar to those of silicon. Calcium silicide, however, possesses very definite and powerful reducing properties on account of the presence of the element. Further, if calcium silicide is decomposed, the silicon obtained is the yellow amorphous variety which is readily oxidized. The final production when calcium silicide is used for reduction, is calcium silicate which possesses valuable slagging properties.

Aluminium is one of the most powerful reducing agents obtainable, and if properly protected, gives very satisfactory results. A most ingenious application of aluminium in this connection is to be found in the quasi arc electrode, where a fine aluminium wire is wound on the rod, a layer of asbestos being wound over the whole. The reducing properties of aluminium have been fully exploited in the Thermit welding process and the Goldschmidt patents for the preparation of metals and ferro alloys.

The Thermit reaction may be summarized by the following equation:—

$$3Fe_3O_4 + 8Al = 4Al_2O_3 + 9Fe.$$

Iron Oxide and Aluminium yield Alumina and Iron.

The reaction applies equally well to the oxides of nickel, chromium, manganese, silicon, molybdenum, tungsten, vanadium, titanium and zirconium, and it proceeds with considerable violence and the evolution of enormous quantities of heat, so that the whole of the contents are melted and the metal separates at the bottom from the slag. By means of this reaction it is possible to prepare alloys of almost any composition.

Another highly successful reducing agent is the metal titanium. It has been used as a scavenger with much success in the steel industry and is equally efficient in welding. Its action is based on the formation of titanium dioxide, thus:—

$$Fe_3O_4 + 2Ti = 3Fe + 2TiO_2.$$

Iron Oxide and Titanium yield Iron and Titanium Dioxide.

It possesses a further advantage in that titanium dioxide is extremely light and separates from the molten metal with great facility. The oxide is also readily soluble in the alkaline slags produced by the fluxes generally used in the welding of iron and steel.

Phosphorus has a limited use as a reducing agent in welding It is very efficient but should be used with great caution, as it forms stable phosphides with most of the metals and if present in excess of the requisite amount, will bring about the separation of the phosphorus eutectic which weakens a weld. This point is brought home in the welding wire for copper welding. A heterogeneous wire or one containing only a slight excess of the correct quantity of phosphorus leads to defective welds.

Slags.—We now have to consider the question of the removal of the products resulting from the use of reducing agents. These are silica, alumina, phosphoric acid and titanium dioxide, and their removal is accomplished in a manner very similar in principle to methods used in the purification of the industrial metals, although the great difference in temperature necessitates the use of very different materials. In welding operations fluxes are used which produce a slag which not only removes the by-products of reduction but also the oxide of the meal which is being welded.

Slag formation and the chemical properties of welding slags is a subject of the greatest complexity, but a very necessary subject for manufacturers of fluxes. The earliest flux in history was the sand used in smith's welding, in which case a complex iron silicate is formed. This silicate, however, decomposes below the melting point of iron and therefore sand alone is unsuitable as a welding flux. The silica slags, however, are of great value in welding and they fall into three classes: (1) soda-silica slags, (2) magnesium-silica slags and (3) soda-calcium silica slags. The soda-silica slags are produced by the use of sodium silicate ($Na_2Si_4O_9$) employed in various forms for welding mild steel, cast steel and nickel steel. They dissolve Fe_3O_4 quite readily and form a complex sodium-iron silicate. The magnesium-silica slags are produced when asbestos is used. The soda-calcium silica slags are products closely akin to glass, and their use is confined to flux-coated electrodes.

All these slags dissolve Fe_3O_4 readily, the soda-silicate variety being the most active in this respect, and they also remove alumina with the formation of alumino-silicates similar to the natrolite ($Na_2O.Al_2O_3.3SiO_2$) or in the case of magnesium and calcium ($CaO.Al_2O_3.2SiO_2$) anorthite.

A second variety of slags used in welding are produced from the element boron, generally encountered as borax ($Na_2B_4O_7$) or boric acid (H_3BO_3), and here the action on oxides is very much simpler. At high temperatures both borax and boric acid yield boric anhydride (B_2O_3) which combines directly with the oxides of copper, cobalt, chromium, iron, nickel and manganese. Thus

(*Continued on page* 32)

*Paper read before the Institution of Welding Engineers, London, February 12, 1924.

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The Unusual Is Not Impossible

NO matter how well trained and experienced an operator may be, there are always a few things going on in the welding industry which he misses, so the job he turns down might prove to be a new lesson in the art. Experienced welding engineers and service men are available for consultation in practically every nook and corner of the country, waiting to serve the welder. They know what other welders have done to solve difficult welding problems. There are also two reliable trade papers keeping in touch with every new development and having the services of the best welding experts of America at their disposal. If a job can be done, the welder who doesn't know how should go the limit to find out. If it can't be done, a good way to save money is to let it alone. When in doubt, ask.

Selling Merchandise vs. Selling Service

GIVEN a prospect who wants to use welding apparatus for a specific job, it isn't much of a trick to sell him good apparatus for the work. But competition is so keen that there are not enough such customers to go around. The selling problem is thus reduced to that of showing where welding ought to be used, and this requires an intimate knowledge of the process. His merchandise is merely incidental to the best type of salesman. He performs a service which keeps his welcome alive.

Railroads Can Aid Welding Development

SEVERAL weeks ago a delegation of railroad workers called upon their superintendent and suggested that, since welding was such an important craft, selected men from different crafts be given apprenticeship training and the welding department centralized. It will be a blessing when this idea spreads through the railroad organizations, for it is just what is needed to assure the highest efficiency in railroad welding. If these huge organizations train their welders in a systematic way, we'll have more good welding, more good welders, and more boosters for welding. The prejudices which have stood in the way of such progress are gradually breaking down.

The Cutting Torch Is Always Useful

WHEREVER the welding torch is used, the cutting torch can pay its own way as a companion tool. Metal parts which are no longer fit for service may be quickly and cheaply fabricated into new and useable shapes, and parts wanted in a hurry may be made up from material found in the scrap pile. These possibilities are always present when the cutting torch is at hand, and every welder should have one at his disposal.

Are Employers Passing the Buck?

AN educator who specializes in vocational training asks: "How many of the men who are interested in the machine industry and who deplore the lack of good material with which to perpetuate it are willing to take the time and trouble to come before the boys in their classes and tell them the opportunities offered in their chosen trade?" Employers who have tried the experiment know that time spent in cooperating with vocational schools is well spent. It has been successfully tried in several large industries, and it suggests a way to increase the supply of good welding operators. Don't wait for somebody else to do all the worrying about training men, but get in touch with your local schools and help them to help you.

THE CAR SERVICE department of the New York Central Railroad maintains a record of the whereabouts of 135,616 company-owned freight cars. Similarly, Prest-O-Lite records the movement of many more cylinders in and out of its 72 plants and warehouses. Keeping these cylinders moving is just as important to the Prest-O-Lite user as car movement is to the shipper.

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SOME CHEMICAL ASPECTS OF WELDING

(*Continued from page 29*)

in the case of copper oxide and borax we have the reaction:—

$$Na_2B_4O_7 + CuO = Cu(BO_2)_2 + 2NaBO_2$$

Borax and Copper Oxide yield Copper Borate and Sodium Metaborate

All the slags indicated in the last three paragraphs have a high melting point and a very high boiling point, and the problems of flux manufacture have not yet been solved. The melting point of the flux must be adjusted to suit the conditions of welding; the melting point of the slag must be adjusted to come well below the melting point of the metal, and the specific gravity of the slag must be adjusted so as to come away clear of the metal.

Slag formation in aluminium welding is a separate subject. The chlorides of sodium, potassium and lithium form the basis of all the reliable fluxes for aluminum welding, and there is every reason to believe that the activity of such fluxes is due to the formation of meta-aluminates of the type KO.AlO. The reaction is difficult to put on paper, but there is no evidence in favor of the theory that alumina is mechanically soluble in the molten flux. The operation is complicated by the low specific gravity of the molten metal and it is essential that the slag should separate completely from the molten metal.

Reference may be made here to the properties of cryolite $AlF_3 3NaF$, which has been used as a flux both in aluminium manufacture and welding. It is unsatisfactory in welding on account of its high melting point, 977°C., so that it solidifies before the molten metal. The ideal flux should melt at a lower temperature than the melting point of the metal or alloy to be welded and should possess, after fusion, sufficient fluidity and a sufficiently low specific gravity as to avoid all chance of its becoming entangled in the molten metal and remaining there after solidification, thereby setting up corrosion. The flux when melted under the action of the blow pipe should not, however, be so fluid as to run off and leave the surface of the metal exposed to the oxidizing action in the atmosphere or of the gases of the flame. It should on the contrary form a viscuous varnish on the surface of the metal and previous to varnishing it should not be easily blown away by the force of gases emerging from the blowpipe, but form an uninterrupted protective layer preventing local re-oxidation of any part of the metal previously deoxidised by the action of the flux.

Fluxes.—Having thus described the general chemical and physical phenomena in welding we may now turn to the complete consideration of the conditions encountered in welding practice.

Welding cast iron by the electric arc cannot yet be described as wholly satisfactory owing to the variation in physical properties frequently met. At present welding with a graphite electrode gives good results but there is scope for a great deal of investigation in this direction and this is at present being undertaken.

Welding cast iron by the oxy-acetylene process, however, can be carried out to perfection. The ingredients of the flux are sodium carbonate and bicarbonate, borax and silica. A rod of high silicon content has been extensively used, for reasons already stated, but recent research has provided rods of special composition, which give much better results than the silicated rods. One of special interest is a rod containing titanium in such quantity as to prevent internal oxidation of both iron and carbon. The flux ingredients are designed to glaze the rod forming an excellent protective coating. The silica combines with the sodium carbonate, giving sodium silicate, which in turn combines with the borax, giving sodium borosilicate with free borax, a slag which is a highly efficient solvent for iron oxide.

Welding mild steel with the electric arc is extremely successful, but in any case a protective flux should be used. The qualifications for this flux are that it should melt at the same rate as the electrode, it should contain a reducing agent and form a suitable slag. A large number of patents have been taken out on this subject, asbestos and calcium salts occurring in most of them, and it would seem that the chief function of the flux is to form a protecting sleeve of gases for the arc.

Mild steel can be welded with equal success by the oxy-acetylene process and the problem of eliminating oxide when welding iron and steel is a very difficult one and has received considerable attention for many years. It has been shown that its reduction by the flame of the blowpipe is not possible and it is therefore necessary to fall back on some form of reducing agent.

Numerous reducing agents are used in the metallurgical industry and experiments have been made with most of them in one form or another. In the welding industry certain of these agents have been used in the form of powders or as an alloy with the welding wire. The use of deoxidizing fluxes in the form of a powder have many disadvantages when used for welding steel. The addition of deoxidizing agents to the welding wire is difficult to attain because most of these agents have a very low density and do not alloy well with iron and steel.

It has been found that a deoxidizing material in the form of a liquid gives excellent results when welding steel. One product on the market is especially prepared for use with welding wire which does not contain deoxidizing elements. It is recommended for use in repair work, for welding sheet metal—especially thick material—and castings. At the high temperature of the flame it slags the oxide, maintains the surfaces clean and prevents inclusion of oxides. It thus facilitates the rapid execution of the weld and, in consequence, reduces to a minimum the oveheating effects and thus eliminates local defects. The material is sold in cans containing approximately one and two pints respectively and is applied by means of a brush to the edges of the weld and the welding wire, previous to welding.

Medium and hard steels require careful handling, but indifferent results are obtained, because of the metallurgical phenomena which intervene. A flux similar to that used for cast iron should be employed. It should be remembered that in these steels the carbon which varies from 0.3% to 1.2% is present, almost entirely in the combined state, that is as iron carbide (Fe_3C) and its various modifications. It is well known that temperature conditions play a great part in the mechanical properties of solutions of iron carbide, and in fact this forms a separate subject which is familiar to all under the name of "tempering." Provided oxidation is prevented by the use of a flux the measure of success of the operation depends on the right heat and mechanical treatments being applied.

The welding of copper is a simple operation if the right materials are used, and in this connection it is essential to use a properly prepared wire containing phosphorus as a reducing agent. The flux used should consist of boric acid, borax and sodium chloride which protects the rod and removes copper oxide by the formation of copper borate, as already described. The sodium chloride constituent of the flux serves to adjust its melting point.

The welding of brasses and bronze is very similar to the welding of copper, specially prepared rods and a flux of similar composition being necessary. The welder should be thoroughly familiar with the chemical composition of the commoner forms of brasses and bronzes, and should be able to select rods of composition suitable for his purpose.

The welding of aluminium is probably the most difficult proposition which the welder encounters, the rapidity with which aluminium is oxidised and the character of the oxide being the chief trouble. It is extremely difficult to weld aluminum without a highly efficient flux, and practically impossible on thin sheets. The method of welding without a flux, known in the trade as "puddling," should be looked on as an emergency procedure as films of oxide remain in the weld reducing its strength and leading to cracks and disintegration.

Chemical Control.—Chemical control concerns more the preliminaries than the welding operation itself and it is essential for a welder to ascertain that all the materials he uses in the form of fluxes, welding wires and rods, gases, etc., have been manufactured under efficient chemical control. Acetylene and oxygen in cylinders are usually delivered in a high state of purity, but those who buy carbide and make their own acetylene have to guard against the two dangerous impurities—sulphuretted

hydrogen (H_2S) and phosphoretted hydrogen (PH_3), which if not removed, lead to the formation of the sulphur and phosphorus eutectics which lead to defective welds. In addition an efficient purifier acts as a mechanical filter and prevents particles of dust and moisture reaching the weld. Consumers would be well advised to insist on their carbide conforming to the specification of British Acetylene and Welding Association and should use purifying materials prepared under strict chemical control.

The principle of the action of all purifying materials is one of oxidation. Permanganates, chromic acid and ferric salts all oxidize sulphuretted and and phophoretted hydrogen to sulphuric acid and phosphoric acid respectively, which are readily absorbed by the material. It is of interest to note that chemical means must be employed for the removal of these two impurities, scrubbers being inefficient.

The manufacture of welding wire also calls for the strictest chemical control in every operation, from the raw material to the finished article. This applies particularly to the manufacture of welding wire for copper and its alloys. The phosphorus necessary must be present in a definite percentage, below which oxidation occurs, and above which the phosphorus eutectic is formed, and the preparation of a copper wire containing a definite percentage of phosphorus is not nearly as easy as it sounds.

The preparation of fluxes for high temperature welding operations is an art, and there are three essential conditions for success, viz., (1) that the ingredients be absolutely pure; (2) that the finished flux be absolutely dry, and (3) that the ingredients be perfectly mixed. The first condition necessitates a complete analysis of all raw maerials. The second condition necessitates special plant and control tests on the finished fluxes, and the third condition demands expert workmanship and strict attention to detail. Consequently the preparation of fluxes should be left in the hands of the chemical manufacturers whose plant, experience and technical staff renders them alone competent to undertake the task.

The remarks in the last paragraph apply in the superlative degree to the preparation of fluxes for aluminum welding. All the ingredients of this flux are medium sized deliquescent crystals, *i. e.*, they absorb moisture from the atmosphere. These have to be reduced to a fine dry powder of uniform composition, and this operation has only been achieved after much research and requires very special plant, suitable for this purpose alone.

Conclusion.—There are many other points of interest and importance which might be mentioned in this paper. It will be gathered that the crux of the chemical aspect is the removal of, and prevention of foreign inclusions in welds, which are the chief cause of failures.

In conclusion, the writer has not attempted to probe too deeply into the subject as it is impossible to do so in the limited time at his disposal. In fact, nearly every single compound mentioned has formed the subject of a number of text books, but it is, of course, quite unnecessary for the welder to assimilate the contents of all these. A clear conception of the chemical aspects of welding, however, is an essential part of the welder's equipment, and this the writer has attempted, with success he trusts, to present.

NEW CESCO WELDING HELMET

The Chicago Eye Shield Company, 2300 Warren Ave., Chicago, is putting on the market a new style No. 11 helmet for arc welders. This helmet is made of pressed fibre and is so small and light as to cause minimum discomfort to the wearer. As a breast protector is not included, the helmet can easily be thrown back over the head to permit inspection of the work. At the same time it is so constructed as to afford ample protection to the operator and is fitted with the well known "Essentialite" protective glass, which is made by the same company.

WELDING LOCOMOTIVE GUIDE RODS

An interesting exhibit was brought to the attention of railroad men at the National Railway Appliance Association exhibition at the Coliseum, Chicago, recently. A new process for repairing locomotive guides was displayed by means of which the General Electric Company claims to have eliminated all difficulties previously encountered in renewing these guides and keeping them up to I. C. C. standards.

The process used was electric arc welding automatically applied. The guides were placed in an ordinary lathe and on the tool post, was mounted the automatic welder. When in operation, the guide remained stationary and the automatic welder traveled along with the carriage of the lathe, depositing electrode metal on the worn surface of the guide. The welding was applied

How Guide Rods Were Welded.

on the side surface of the guide covering a width of two inches, beginning the welding on the inside and laying down adjacent beads working to the outer edge. Two layers of beads were required to build up the worn spot, a total of ⅜" on each side. This was then machined away ⅛" on each side, leaving a ¼" finished built-up stock. The length of the built-up guide was five feet. A total of three hours was required for welding both sides, using 150 amperes 20 volts across the arc and ⅛" diameter electrode wire.

FORT WORTH HAS FINE WELDING SCHOOL

The Knights of Columbus Evening School in Forth Worth, Texas, has one of the most complete courses in Oxy-Acetylene Welding to be found in the country. The instruction given covers the theory of welding completely, and the practical work makes the student familiar with the fundamentals of the most common types of welds in the metals usually encountered in

Fort Worth's Welding School.

welding practice. It is under the supervision of Mr. Thomas Sweeney, of the Burdett Oxygen Company. During the term which recently closed nearly 30 students were enrolled in the welding class, and many of them were able to qualify for the Certificate of Proficiency issued by the school. Mr. C. F. Roehl, Principal, states that they are preparing for a larger class, and larger quarters for the forthcoming scholastic year.

WELDING IN ITALY

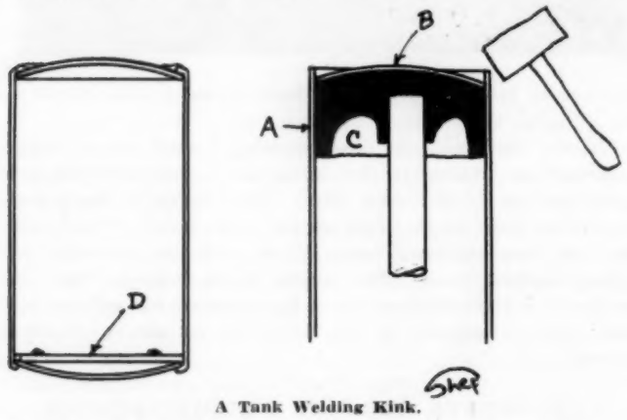
How a Bronze Bell Was Welded—A Good Method of Welding Convex Heads in Small Tanks

Rome, Italy.
Sunday.

Dear Ed:

I never expected to land down here in Italy, but seeing I was so close, and my passport could be arranged, decided I'd just slip over for a few days and give this country the "once-over." I'm glad now that I did, for things are much different than they are in France. I don't know one word of Italian so naturally you can imagine how I feel. Remember the old saying, "Do in Rome as the Romans do?" Well, I'm trying to do that very thing but am having a difficult time.

The country itself, is wonderful. I'd just like to sit down and write you all about it and some of the queer experiences I've had, but there isn't much time right now. Instead I want to tell you about some of the interesting jobs I saw this week, while they are fresh in my mind. All the experiences, etc., can wait until I see you, then I'll spring them all at once. However, a word about Italy as an industrial nation can not be passed up. Somehow or other, I have always thought of Italy as a country living on its past history. The Roman Empire certainly left its mark. Visions



A Tank Welding Kink.

of Italy and industry never seemed very close in my mind. In knocking about this past week I've learned many things and have been forced to change my mind. This country has many natural resources and is forging ahead daily with its industries . It really appears that in a few years, Italy will take its place among the great industrial nations.

The welding and cutting apparatus used here is much the same type as that used in France. Everything is of the low pressure generator style. This is no doubt due to the same reason as in France, namely;—Acetylene tanks are few and not popular on account of the government limiting their diameter to about six inches. If any usuable amount of gas is to be stored inside it makes the tank so long that is very hard to handle. (I saw some cylinders in France fully eight feet high.) In addition to this, there are no medium pressure generators.

Having taken a few jaunts here and there to other towns and, as I stated before, observed some interesting work, thought I'd tell you about three different jobs I saw performed in as many different shops. The nature of these jobs is in no way related, except possibly the last two. Each simply brings out an idea.

The first, and probably the most interesting to me, concerns a cracked bronze bell. While I've read any number of articles about welds of this kind, the problem here was slightly different than usual and that accounts for the interest. Instead of being an ordinary single type bell, this was from a set of chimes. You probably appreciate from that statement the importance of not so much the welding operation as that of restoring the proper sounding qualities. But the welding itself was not the simplest problem in the world either. The bell was not of the ordinary school-house variety; it weighed over eighteen hundred pounds.

I did not see the bell before the welding began. As it was, I arrived when the crack, which had been eighteen inches long, was just about half welded. The bell had been preheated to a dull red and was completely covered over with the exception of the part being welded. The crack had been chipped out to form a right angle so that complete penetration and fusion would be assured. I knew full well why the crack should be chipped out, rather than by the use of the flame, as is so common on cast iron, but I thought I'd see whether the Italians would offer the same reason. I put the question through my interpreter. "It's impossible to burn the metal out with the fire and leave the balance of the metal in good condition for welding because the metals with the lower melting degree than the copper base will change character and make good fusion difficult." (This is a literal translation, but it hits the mark all right.)

"As those special rods?" I asked, pointing to the filler rods being used.

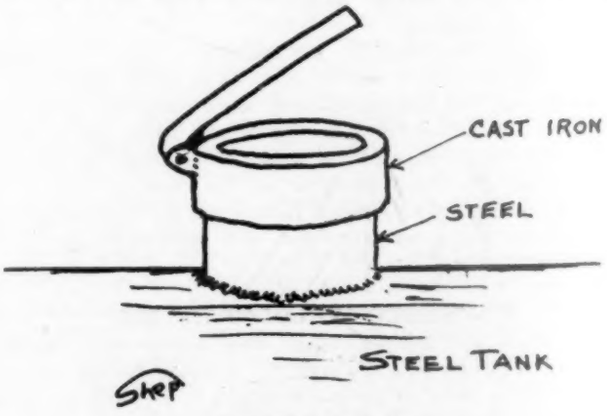
"Are those special rods?" I asked, pointing to the filler rods being used.

My man passed on the question to the manager and soon had the reply for me.

"Those metal sticks," he informed me, "are very very special. First, some of the original metal which is removed from the crack is taken to the foundry. They find out what is in it and then make these sticks of the same material."

I noticed the welder was using the same method of applying his flux as they did in Paris. He had a large box about one foot square and six inches deep close at hand. This was filled with flux and every once in a while he would grab a fist full of the powder. The torch would then be removed from the weld and he'd throw the flux all over the part being fused.

I certainly wanted to see and learn how they restored the original tone to this bell for I had visions of its being very much out of tune, due to the fact that altogether too much metal was being added. When I asked about the time they thought the bell would be cool enough to start finishing, I figured there was some mistake when told in about two hours. Here was a mass of bronze, red hot, which I knew, ordinarily



Filler Collar for Tanks.

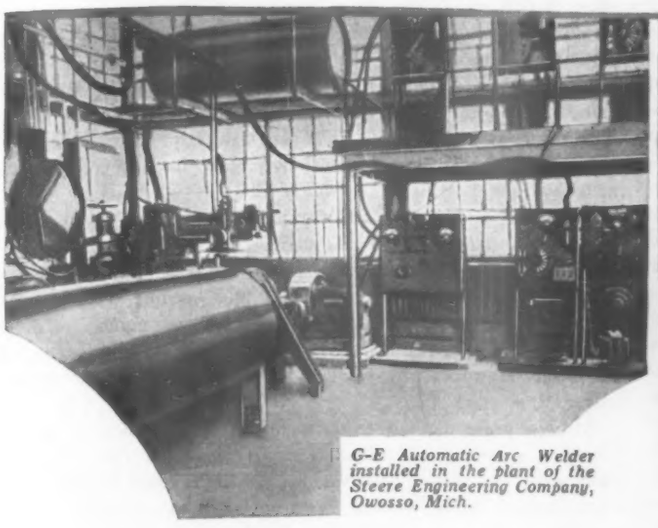
would require from twenty-four to thirty-six hours to cool, and they were telling me, two hours.

I told them I didn't understand; did they mean two days?

When the manager was asked this, he grinned; shook his head, took out his watch and indicated two hours on the dial. Then it dawned upon me that they always cool bells of this type in water to restore their resonant qualities. I decided to wait and see the whole thing through, and I was mighty glad I did.

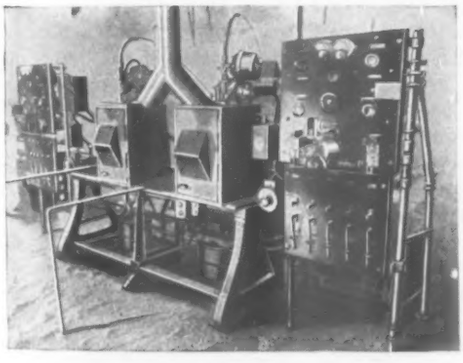
Sure enough, when the welding operation was finished, this part

Why the Automatic Arc Welder?

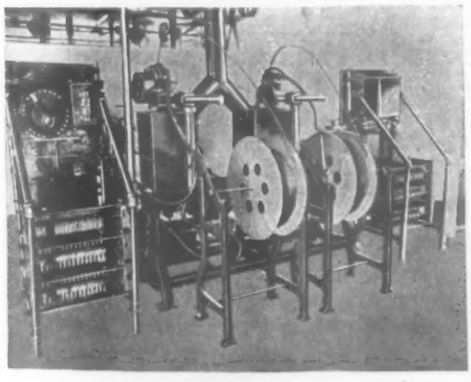


G-E Automatic Arc Welder installed in the plant of the Steere Engineering Company, Owosso, Mich.

At the plant of the Otto U. Hoffman Company, Philadelphia, Pa., a G-E Automatic Arc Welder is used for the welding of stocking forms.



G-E Automatic Arc Welders used in the Lowell plant of the Saco Lowell shops, largest manufacturers of textile machinery in the world.



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was covered over and left for about twenty minutes until the heat in the welded portion was the same temperature as the balance of the metal; then they prepared for quick cooling. I was anxious to see how this was accomplished for I knew they wouldn't dare try to lift the bell by its lugs, when they were so hot, for they would simply tear them right off. Therefore dipping was out of the question. Apparently this was not the first big bell that this company had handled for they were equal to the occasion. Instead of lifting the hot bell, four hose lines were produced; the covering of the bell removed and four streams of water poured on it, one on each side. These were moved about to cover as much surface as possible. Say Ed! Did you mention steam? Zowie! There was nothing else but, in that shop from the moment the first drop of water struck that hot surface until it was cool. Everybody had to get outside except the four men handling the hose lines.

It was surprising how quick they got that big mass of bronze cool. After the air had cleared up a bit an overhead conveyor picked up the bell and carried it to a dry place, where it was immediately tested for checks and tone. They seemed to be satisfied that there were no cracks, for it rang true enough. Then came the most interesting point of all, and one which was puzzling me most. Inasmuch as this bell had to be tuned just right, in order to fill in the correct note for the rest of the chimes, how could the test be made without hanging this bell in its place with the rest of the bells and testing it there? I certainly could not guess the answer but that didn't seem to bother my Italian friends, for they already had the answer all figured out. They produced a large tuning fork, struck the bell and then the fork, and checked the vibrations. They were apparently well pleased with the results, for orders were given and two mechanics immediately brought their chisels into play and started cutting off the surplus metal on the weld. When this had been going on for a little while, another test was made. It was then that I noticed for the first time that the workmen were directing their gaze, with great anxiety, toward a stranger. This man, I soon found out, was a musician who was called in to check the vibrations of the bell.

The chipping continued, with occasional tests, until most of the surplus was removed. It was very noticeable that as the extra metal was removed that the tone of the bell was improved. After the chipping stopped files were brought into play, and from then on the tests were made more frequently. It was very apparent that they were progressing in the right direction. for even I, could notice that each test showed the tone of the bell gradually approaching that of the tuning-fork.

Was sorry I couldn't wait for the finish, but the hour was growing late and the last train for Rome would soon be leaving, so I decided to call it a day. They were so close to the right tone when I left that I saw it was merely a matter of filing and testing until the desired results were obtained. As I boarded the train, I felt that there were a couple of tricks about welding bells just learned that would certainly interest you. I hope they do.

The following day I went through a plant where compressed air tanks were being made. The proceedings in general were much the same as in our American plants; all but one operation. It may be that this too is used, but at any rate I've never seen it done just this way. The operation I refer to is the flanging over of the shell at the ends. The tanks in question were being made of sheet metal about one quarter inch thick. (The standard of measure is entirely different over here. The inch and pound are never used, but I can't get on to their system so will use the good old U. S. A. standards.) As I was saying, the material was about one quarter of an inch thick and after the shells had been welded both outside and in, the next thing on the program was to weld in the ends. These were "dished" and each end had to have the convex side out. In order to make the operation more clear I have made a sketch or two which you will find enclosed. To handle the first end; the shell (A) is slipped over the forming head "C." Then the end "B" is dropped in place and the end of the shell is heated and turned in as illustrated. The end of the shell and head are then welded togther and that end is finished.

With one end already closed, the flanging of the other end presents another problem. This was taken care of very nicely by first slipping in a ring "D", made of ordinary band iron and "tacking" it in four places on the inside edge. The shell is then turned up in the same position as when the first end was flanged and the second end dropped into place. The ring "D" now takes the place of the form "C" and the same procedure as in the first instance finishes up the second end. While this same method may be used in our country I have never seen it. The result at any rate makes a very attractive tank.

Now the third stunt I mentioned really isn't a welding stunt at all, although it is very closely related. One manufacturer I encountered had had much trouble in producing a large filler opening for oil tanks. This opening had to be tight, but not to the extent of holding any pressure. It was simply to prevent any oil from leaking through the filling opening when the tank was filled and being moved. He had tried any number of different couplings and fittings, but when the oil splashed around on the inside it would always leak through and run down the outside of the tank.

After a great deal of experimenting the filler now in use was found to overcome all difficulties. It's really a very simple arrangement but shows how various problems must be met by the manufacturer using welding in his production. It was necessary that the opening be six inches in diameter, so pieces of steel tubing of that measurement were cut off about four inches long. In one end holes were punched very close to the end. These pieces were then sent to a cast iron foundry, togther with a pattern and a casting made around the perforated end. This casting contained a groove in which a rubber gasket could be inserted and also had lugs to hold a cover. I examined several of these filler collars and they certainly looked fine, and from all accounts functioned just as good. As you will guess, the welding operation was a very simple thing, for it was simply a case of welding steel to steel. The heat from the welding operation seemed to have no effect upon the casting. It would appear that the cast iron, when being poured at the foundry in all probability became fused to the steel tubing and was helped to some extent by the holes.

Other than the foregoing, I have nothing further to report at the present. Will ring off and see where Fate will land me for my next letter.

Yours without a struggle,

Shep.

ELMER SMITH STILL BROADCASTING

E. H. Smith, president of Smith's Inventions, Inc., who some time ago broadcasted a lecture on the subject of "Oxy-Acetylene Welding," is spending quite a bit of his time lately in lecturing and talking on the Oxy-Acetylene Welding and Cutting Process, and in giving demonstrations with liquid oxygen. On April 21st he gave a talk on "Oxy-Acetylene Welding and the Uses of Liquid Oxygen," before the Northwest Chapter of the American Steel Treaters' Society, at the Manufacturers' Club in Minneapolis. Similar talks were given before the same society on April 23rd and 24th at Moline, Illinois, and Milwaukee.

C. G. M. A. ACTIVITIES

John H. Luening, the new secretary of the Compressed Gas Manufacturers' Association, announces that a Spring Luncheon will precede the May Executive Board Meeting, which is to be held on Thursday, May 15th, at the Hotel Astor, New York City.

The Canadian Section of the Association is meeting at Montreal on May 13th, and it is planned to proceed at once to Shawinigan Falls, where the great industrial developments at that point will be inspected.

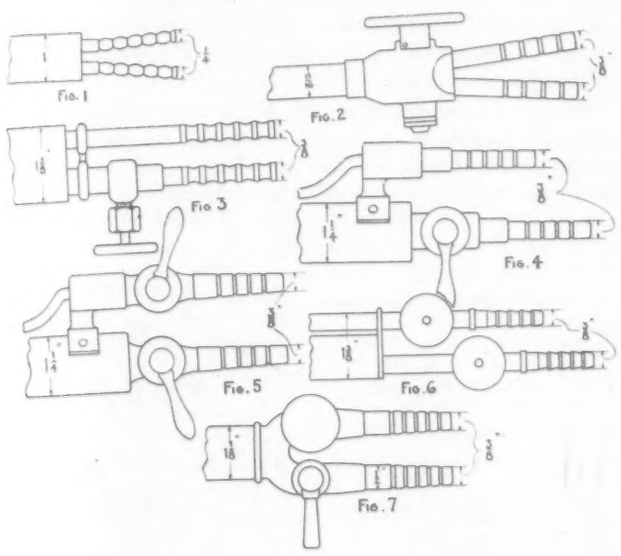
STANDARD HOSE CONNECTIONS

Should They Be Red or Black, or Both?—Some Examples of Present Lack of Standards

By C. J. Nyquist*

THE question as to what colors should be used for hose carrying oxygen and acetylene is still with us. It is one of long standing and one which has so far been answered according to individual opinion. The total result of efforts, up to this time, to come to an agreement on standardization of the colors of the hose, or, better still, standardization of hose connections, has been fittingly expressed by one "Board on Welding Research and Standardization," in this way:

> "It is the opinion of those connected with the work of the Bureau that our efforts could more advantageously be directed to other lines than of standardization of



> connections for gas welding apparatus."

Another organization which has for many years taken an active part in the promotion of oxy-acetylene welding, disposed of the question at one time by a motion that:

> "The Secretary is requested by this Committee to inform Mr. ..... that it is commercially and practically impossible to adopt such standardization at this time. Further, from the information in the possession of the Committee, it would seem that any vital necessity for such standardization, is not apparent."

The necessity for an agreement on a safe and practical method to prevent interchange of the hose has, nevertheless, been actual and apparent to many oxy-acetylene men for quite a number of years. Theo. Kautny makes the following statement, on page 207, in his "Handbuch der Autogener Schweissung," first edition, published 1909:

> "In order to prevent interchange, it is necessary that the connections between the hose and the torch is either provided with *different* and strong hose fittings or with connection nuts having *different* and coarse threads."

Mr. Kautny further states on page 382 in the second edition of his handbook, published 1912, as follows:

> "If when using an autogenous welding equipment an interchange of hose carrying the fuel gas and the oxygen takes place, it may result in a serious explosion in the torch and it is therefore advisable to use for the fuel gas a red and for the oxygen a black hose. On all welding torches which have threaded connections between hose and torch it is advisable to have *different* connections for both gases."

The Davis-Bournonville Company, one of the earliest manufacturers of oxy-acetylene apparatus in this country, makes this statement in one of their instruction books:

> "Fine threads are used for the oxygen hose connections to both torch and regulator, and coarse threads for the acetylene connections, so that the hose will not be interchangeable."

The Welding Encyclopedia, in all of its three editions, says this:

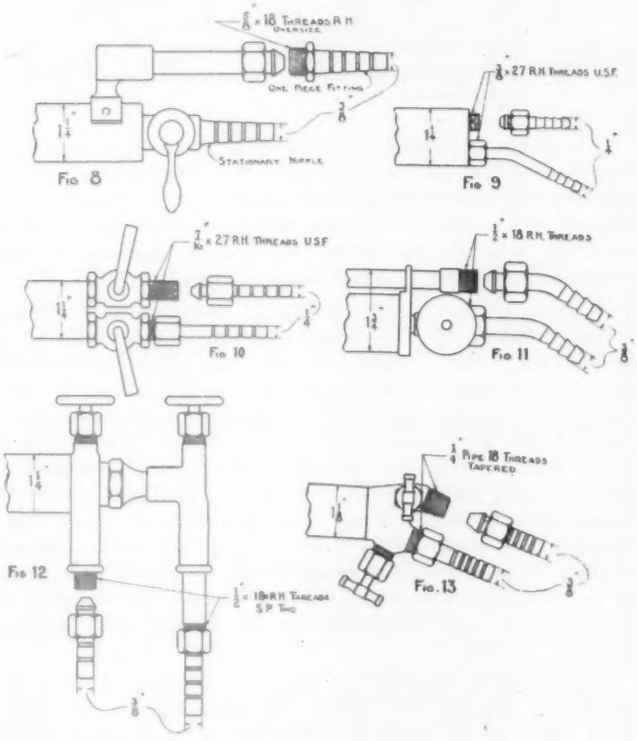
> "Two colors of hose are used for gas welding; black for acetylene and red for oxygen. This is to prevent confusion when connecting apparatus."

C. H. Burrow in his Textbook on Welding and Cutting Metals, published 1915, takes the opposite stand:

> "Two colored hose are provided to distinguish between the oxygen and acetylene, and it is recommended to use the black hose for the former and the red hose for the latter."

The Oxweld Acetylene Company's Manual of Instruction, published 1918, contains the following on the subject:

> "Two colors of hose are used, black for acetylene and red for oxygen. This is to prevent interchanging when



> connecting the apparatus."

Lorn Campbell, Jr., in his "Oxy-Acetylene Manual," published 1919, recommends that:

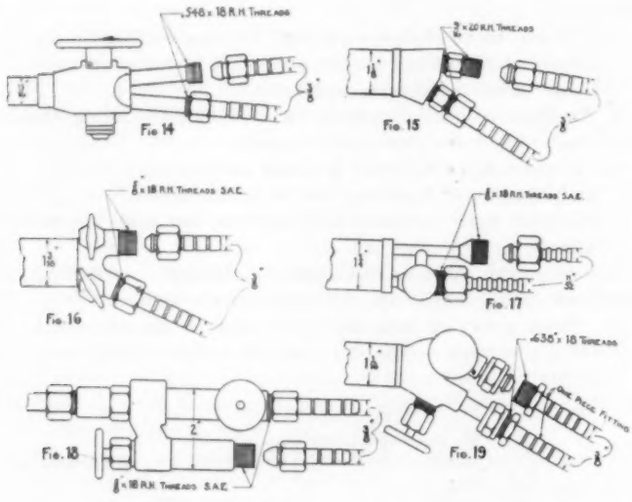
> "The black hose should connect the oxygen regular to the torch valve marked 'OX' and the red hose, the acetylene regulator to the torch valve marked 'AC'."

And so it goes—head or tail—the chances are about equal.

*Carbic Mfg. Co.

A study of catalogs and price lists, old and new, issued by manufacturers of oxy-acetylene apparatus is quite interesting and reveals the position taken by them on this question. Space forbids reference to all of them but the following list, while containing but a few, past and present, should be convincing. Both sides cannot be right, so evidently there is need for an agreement in order to remedy the present situation.

	Oxygen	*Acetylene*
Linde Air Products Company	Red	Black
D.-B. Company	Black	Red
Air Reduction Company	Red	Black
Vulcan Process Company	Black	Red
Harris Calorific Co.	Red	Black
Imperial Brass Mfg. Co.	Black	Red
Oxweld Acetylene Company	Red	Black
Cox Brass Mfg. Co.	Black	Red
K. G. Welding & Cutting Co.	Red	Black
U. S. Welding Company	Black	Red
Fidelity Brass Mfg. Co.	White	Black



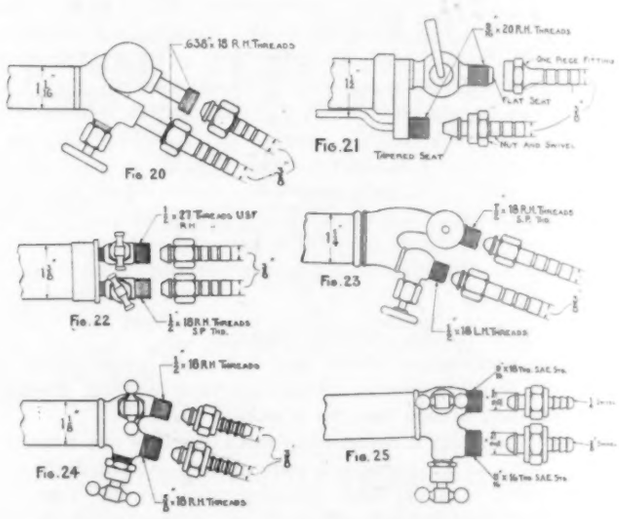
It is rather unfortunate that the early manufacturers of oxy-acetylene torches did not anticipate the complications and the stubborn divergence of opinion which later developed on the subject of hose fittings. If they had there would have been no need for hose of two colors, the present multitude of hose connections and the so-called torch adapters.

In the early days of the industry, in this country, the oxygen cylinders owned by The Linde Air Products Company were painted red. The Company, at that time, also manufactured oxy-acetylene apparatus and carried out the color scheme by painting oxygen regulator bodies red and using red oxygen hose. Acetylene cylinders were painted black and logically the Company chose to use black acetylene hose. The then existing Davis Oxygen Company, however, painted its oxygen cylinders black and the Davis-Bournonville Company, being under practically the same management, used black oxygen hose, claiming that red hose should properly be used for the inflammable gas. Other manufacturers of oxy-acetylene apparatus apparently decided the question on the merits of these arguments, as they judged them—perhaps some just decided.

Today oxygen cylinders are painted in different colors for the purpose of identification. Unless the manufacturers of oxygen could agree on or would be compelled to adopt either red or black as the color for their cylinders, it would of course be impractical to decide the color on oxygen hose by the old standards. Just why it should be necessary to emphasize the danger of the fuel gas by the use of red hose is not clear to me, as nearly all flashbacks beyond the torch valves that I have had the opportunity to observe, have damaged the oxygen hose, and for the simple reason that the combustion of its rubber lining is supported by the oxygen in the hose. The acetylene hose, being nearly always filled with practically pure acetylene, the propagation of the flame in this hose is, of couse, rapidly checked. Granting that either hose can at times contain mixed gas through interchange or through back-pressure and that the acetylene hose may occasionally contain gas mixed with air, I am quite sure in my own mind that the actual danger of mixed gas in the hose is very much exaggerated.

It is, however, both costly and annoying to have hose ruined and torches, mixing devices and tips plugged through flashbacks. It is not economical for manufacturers of hose, for supply dealers and for customers to be compelled to carry stocks of hose in two colors when one kind will do as well, and it is useless for one manufacturer of apparatus to try to prevent the use of competitors' torches by special hose connections—as useless and impractical as the makeshift many manufacturers now list under the name of torch adapters. Furthermore, it is a waste of time to argue about colors of hose, when a decision one way or the other does not settle the question as rubber hose, whether red, black or white, soon takes on a dirty dark gray appearance after some use. It is also advantageous, as when working in dark places, to be able to distinguish between the oxygen and the fuel gas hose without regard to color.

Merely to state that it is not at this time commercially and practically possible to standardize connections for gas welding and cutting apparatus does not meet the issue. It will have to be met some time, regardless of whether the industry does it voluntarily now or chooses to wait until forced to comply with State regulations which may not be uniform throughout the country. The change to a standard will, no doubt, prove temporarily inconvenient, but in the end the advantages to all concerned will more than compensate for the cost and trouble.



The comparatively few illustrations in this article of various hose connections illustrate both the development of this detail of torch construction and the need for standardization. Figures 4, 5, 7, 8, 19 and 20 are varieties of the same original torch design. Fig. 13 shows the use of tapered threads in connection with conical metallic seats, which is obviously incorrect, and Fig. 21 the use of both flat and conical connection seats on the same torch. Fig. 22 illustrates an effort to prevent interchange of hose by different pitch of thread, Fig. 23 by right and left hand threads, and Fig. 24 by different sizes of hose connections.

By the threads and connection sizes shown by Fig. 25, the effort is made both to prevent interchange of hose and to avoid the use of pipe threads. One well known Corporation now specifies 9/16 inch by 18 thread S. A. E. for oxygen connections, and 11/16 inch by 16 thread S. A. E. for acetylene connections, having had an unfortunate experience when an operator connected the

oxygen hose to a fuel oil tank fitted with standard ¼ inch pipe thread inlet.

Probably every designer of oxygen-acetylene apparatus has his own individual ideas in regard to the proper sizes and shapes of hose connections. A compromise will have to be arrived at, based on points of safety and practicability. For practical reasons it may be necessary to adopt a larger set of hose connections for larger sized torches and a smaller set for lighter torches, both complying with the same safety requirements.

When once a standard is adopted and in use, it will prove both economical and convenient and will certainly eliminate the present very unnecessary risk, waste and confusion.

A. W. S. ANNUAL MEETING

The annual meeting of the American Welding Society was held last month in the Engineering Societies Building, New York City, with the following program:

Wednesday, April 23

Morning

Resistance Welding Committee, Hermann Lemp, Chairman.
9:30 a. m. to 12, 10th floor.

Completion of summary setting forth the present state of the art. Consideration of future work of committee. Election of officers.

Afternoon

Electric Arc Welding Committee, H. M. Hobart, Chairman
2:00 p. m., 10th floor.

Plans for completing elaborate series of investigations started during the War, fabrication by welding in structural work, welding of non-ferrous metals and the use of fluxes and slags in arc welding.

Evening

Smoker, American Welding Society
8:00 p. m., 5th floor.

Note: This section is a new feature in connection with the Annual Meeting of the Society. Smokes and cider were distributed. A motion picture on the "Application of Welding in the Plant of the E. G. Budd Manufacturing Company" was shown by Mr. Jos. W. Meadowcroft, Superintendent of Welding. The Master of Ceremonies was Mr. C. J. Holslag.

Thursday, April 24

Morning

Business Session of American Welding Society
9:30 a. m. to 12, 5th floor.

Program

1. President's Report of Year's Activities.
2. Reports from (a) Finance Committee.
   (b) Meetings and Papers Committee.
   (c) Research Department (American Bureau of Welding).
   (d) Report of Tellers Committee on Election of Officers.
   (e) Introduction of New President.

Afternoon

Board of Directors, American Welding Society
(Including retiring and new members).
2:00 p. m., 10th floor.

Program

1. Review of progress during past year.
2. Introduction of new President.
3. Plans for coming year.
4. Appointment of Committees (a) Executive.
   (b) Membership.
   (c) Finance.
   (d) Meetings and Papers.
   (e) Revision of By-laws.

1:45 p. m., Inspection Trip to Brooklyn Navy Yard.

Through the courtesy of Capt. S. V. Graham an inspection trip was arranged to the New York Navy Yard. The trip included an inspection of the Oxy-Hydrogen and Acetylene Generating Plants and thence to the shipways where the battleships "Indiana" and "South Dakota" are being cut into scrap. The inspection trip also included visits to the plate shop and machine shop and other departments in which gas and electric welding are being used.

Evening

The Third Annual Dinner of the American Welding Society
7:00 p. m., Park Avenue Hotel.

Friday, April 25

Morning

American Bureau of Welding
9:30 a. m. to 12, 11th floor.

Program

1. Progress Reports by Research Committee Chairmen.
2. Election of Officers.
3. Discussion of Policies.
4. Discharge of Committees that have completed their work.
5. Appointment of new Committees.

Afternoon

Gas Welding Committee, S. W. Miller, Chairman
1:30 p. m., 11th floor.

Completion of Summary on Pipe Welding. Program for future activities.

Evening

Technical Session of the American Welding Society
8:00 p. m., 5th floor.

Program

1. Flexibility Versus Rigidity in the Design of Welds.
   a. Carbon Arc Welding, J. C. Lincoln.
   b. Gas Welding, S. W. Miller.
   c. Metal Arc Welding, C. J. Holslag.
   d. Resistance Welding, H. A. Woofter.
   e. Thermit Welding, J. H. Deppeler.
2. Welding in Railroad Shops, A. G. Pack, Chief Inspector, Bureau of Locomotive and Boiler Inspection, Interstate Commerce Commission.

Saturday, April 26

Specifications for Steel to be Welded Committee,
W. J. Beck, Chairman
9:30 a. m., 10th floor.

Plans for future work of Committee.

New officers elected for the current year were: E. H. Ewertz, President; C. A. McCune, Treasurer; M. M. Kelley, Secretary; T. A. Wry, Vice-President; J. D. Conway, Vice-President; H. S. Mann, Vice-President; A. V. Thompson, Vice-President; C. L. Jones, Vice-President.

CAVE WELDING MOVES TO NEW LOCATION

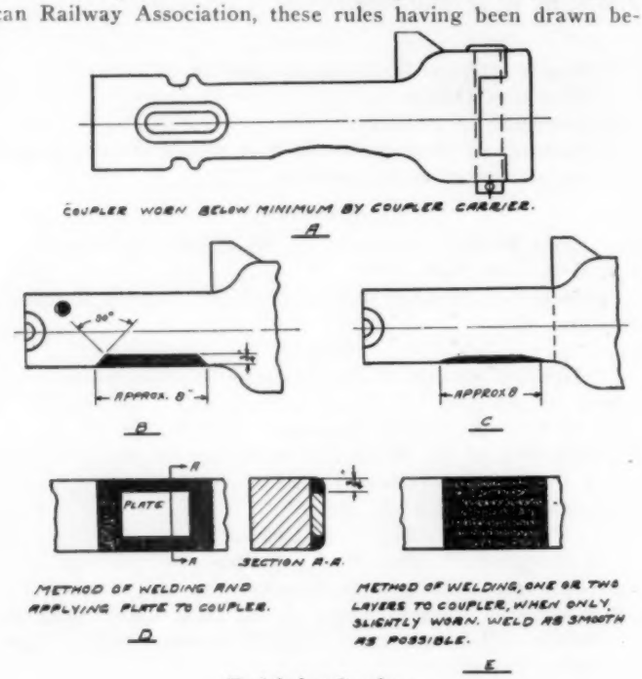
Announcement has been received of the removal of the Cave Welding Company, of Springfield, Mass., to new quarters at 453 Worthington St. It is stated that the change has been made necessary by rapidly increasing business, and that in its new home the floor space available for jobbing and manufacturing will be double. The Springfield Union in a recent article regarding the growth of this company mentions it as the first job welding shop in the United States; it having been established in 1908, by Henry Cave. The Cave Welding Company enjoys the reputation of having one of the best and most completely equipped plants of its kind in the country. It is equipped to handle anything from small parts up to heavy castings weighing several tons, and does all sorts of tank and sheet metal work in repair and manufacture. It has installed the latest type of machinery and devices for both Electric and Oxy-Acetylene Welding. It also maintains a force of welding experts and proper equipment for rendering welding service anywhere outside of the shop, and acts as a jobber and retailer in the sale of welding equipment and supplies.

ARC WELDING STEEL CAR CASTINGS

Modern Methods of Reclaiming Car Bolsters; Side Frames and Couplers—Why Annealing is Necessary

By H. R. Pennington†

IT is comparatively recent, probably within the last five years, that the practice of reclamation in this field has been accomplished in a reliable and satisfactory manner. Even at the present time the practice is not extensive, mainly due to interpretation of the Interchange Rules of the American Railway Association, these rules having been drawn be-



Reclaiming Couplers.

fore the arc process came into general use on railroads and were intended mainly to facilitate oxy-acetylene welding.

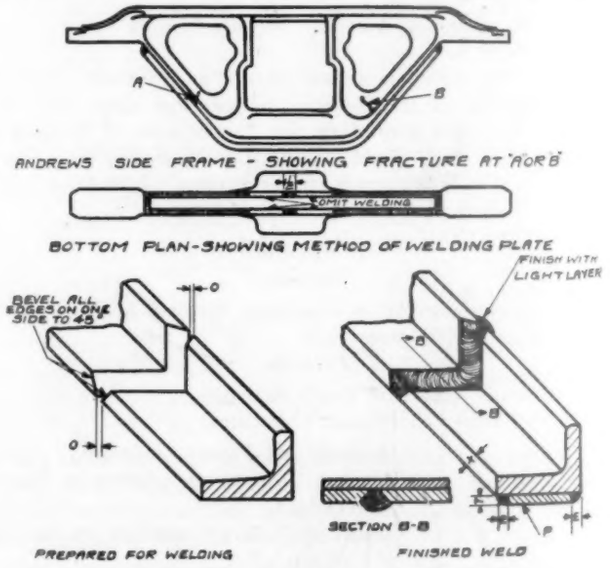
The use of cast steel castings coming under this classification, such, for example, as coupler bodies, knuckles, truck sides and bolsters, are rapidly and constantly increasing. Obviously, the question of reclamation of such parts has assumed more and more importance with their increased use. At the present time the rate of development of defective castings amount to considerable tonnage per month, on individual roads of average size.

Examples of the potential savings in this class of work is shown below from results of test and records of actual practice:

New coupler body, price each, approximately	$17.00
Average cost reclamation, each	2.13
Savings	$14.87
New truck sides, price each, approximately	$20.00
Average cost reclamation, each	7.14
Savings	$12.86

Truck bolsters, etc., afford similar savings as the examples given. The guaranty on such castings are from three to ten years, with no greater percentage of failures than that of new only scrap value; when reclaimed, however, this value is retained. To give some conception of the volume involved, assuming a railroad operated 50,000 freight cars (there are many roads which operate a much greater number) it would have in service 200,000 truck sides. Although all truck sides are not cast steel, most all roads are adopting them and have been for a number of years. Assuming 50 per cent of the above number to be cast steel, and, if the average life is twenty years, which, according to the records is conservative, the annual depreciation would be at the rate of $100,000 a year. If 50 per cent of this value can be reclaimed, which is also conservative, the annual savings represented by this one item alone, based on example given above, would be, roughly, $35,000. A few roads are realizing such savings on this and similar items, but in comparison to the potential savings on all of them, the surface has hardly been scratched.

While engaged in railroad work an opportunity was afforded me to observe results of the welding on steel castings as generally practiced. This practice in a majority of cases amounts simply to beveling the fractured edges and welding without special consideration or attention on the part of anyone. The result of this practice has been very unsatisfactory, in some instances causing failure in service of such vital parts as truck sides, with attendant derailment of trains in at least two



Welding Truck Side Tension Member.

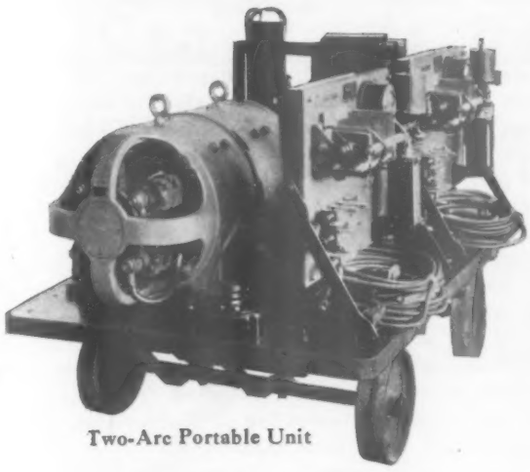
instances on a single road, to the writer's knowledge. Additional evidence of the fallacy of improper applications of welding to such parts was found by the fact that parts so welded failed after a very short period of service, seldom exceeding one year.

In view of the above, it is felt that the outline of a practice for reclamation of such parts, which has been in use over four years. Such parts failing under their guaranty period possess and unwelded similar parts, should be of interest.

Further, it is hoped that this practice will form a basis for

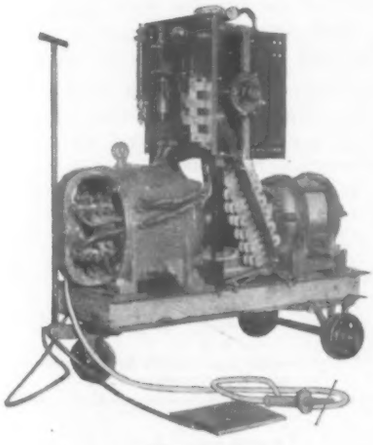
*President before January, 1924, meeting of Northern New York Section, A. W. S.

†Welding Supervisor, Chicago, Rock Island & Pacific R. R.



Two-Arc Portable Unit

Two-Arc Gasoline Engine Driven Unit



Single Arc Portable Unit

PORTABLE
WILSON
WELDING MACHINES
FOR
EVERY WELDING NEED

Single Arc Gasoline Engine Driven Unit

"Color-tipt"

WELDING WIRE

SPECIAL GRADES FOR WELDING
CAST IRON—BRASS—BRONZE
STEEL—MONEL METAL

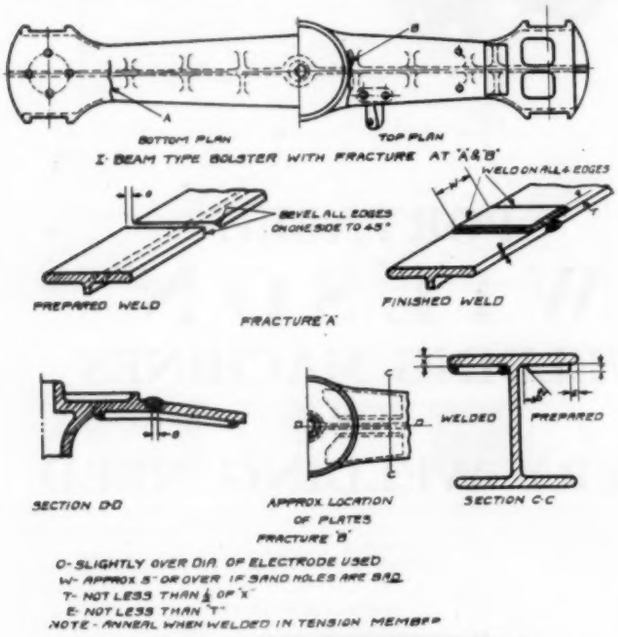
Grade No. 12 Monel Metal Produces a
Machinable Weld in Cast Iron

WILSON WELDER & METALS CO., Inc., New York

the determination of a practice to be recommended for presentation to the American Railway Association on Interchange Rules.

Recommended Practice

The first consideration of a fractured part is whether or not the part is primarily fitted to be returned to service. To determine this, before any preparation for welding is done, the fracture and a considerable area in its vicinity should be cleaned by sand blasting to expose any defects. A close inspection of the completed part should then be made. If an unusual number of defects are found, such as gas pockets, sand holes, shrinkage cracks, porosity, etc., the casting should be discarded and not welded, especially if such defects are present in the tension member of the past. In addition, such parts should not be welded unless it is possible to increase the sectional area completely over the defective portion by not


BOTTOM PLAN
TOP PLAN
I-BEAM TYPE BOLSTER WITH FRACTURE AT 'A' & 'B'
WELD ON ALL 4 EDGES
BEVEL ALL EDGES ONE SIDE TO 45°
PREPARED WELD
FINISHED WELD
FRACTURE 'A'
WELDED
PREPARED
SECTION D-D
APPROX. LOCATION OF PLATES FRACTURE 'B'
SECTION C-C
O- SLIGHTLY OVER DIA. OF ELECTRODE USED
W- APPROX. ⅝" OR OVER IF SAND HOLES ARE BAD.
T- NOT LESS THAN ¼ OF 'X'
E- NOT LESS THAN 'T'
NOTE - ANNEAL WHEN WELDED IN TENSION MEMBER

Repairs of Castings That Have Failed Through Fatigue.

less than 50 per cent. By defective portion is meant not only the fracture, but any neighboring metal that may indicate weakness due to imperfections in the casting.

Type of Joint

The proper reinforcement is best and most efficiently provided by the use of a strap type of joint, the strap being applied on the side opposite from which the welding is done. In the case of tension members on truck sides, the practice of extending a reinforced plate along the full length of the tension number is felt to be advisable, this practice being arrived at after extensive use of narrow reinforcements, both by building up and by use of a short strap type of joint, which in service resulted in failures adjacent to the reinforced area. It seems that the increased stiffness of a localized reinforcement concentrates the strains adjacent to the reinforcement, resulting in failure at this point.

Sketch, Fig. 1, shows recommended reinforcement of truck sides tension members, together with preparation of fracture.

Truck bolsters are repaired in a similar manner, except that reinforcement is confined to the defective area, unless in cases where a certain class of equipment or, rather, a certain type of bolster, is found to be of a weak design, in which case fractures are repaired and reinforcement similar to that of truck sides is applied to the tension member of bolsters.

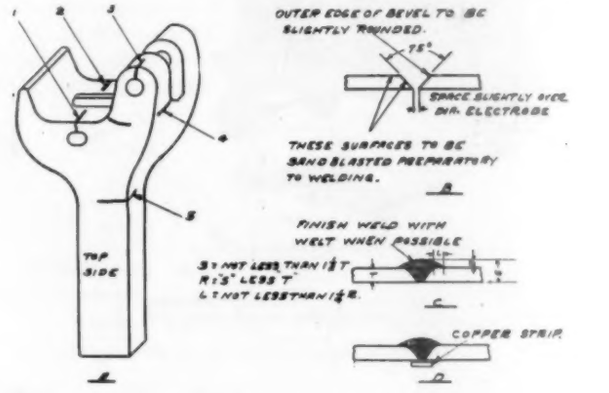
Sketch, Fig. 2, shows recommended method employed where castings are originally of proper design and have failed only from imperfections or fatigue.

Sketches, Figs. 4 and 5, show recommended practice for reclamation of couplers.

Annealing

Although proper and careful workmanship, methods, etc., are essential to successful reclamation, no less is the importance of proper and careful annealing of such parts after welding. The necessity for this is obvious, since in most all cases there is no occasion for reclamation until the metal of the part has developed fatigue, and although this weakness may only be evidenced at the point of fracture, for commercial purposes, it is safe and should be assumed that the neighboring matter is at or near the point of failure, and unless the initial cause of failure is removed, the repairing of the fracture is practically useless. In addition, the ill effects of the welding operation on base metal, as well as strains resulting from welding, should and must be removed if satisfactory results are to be expected. All of this is taken care of by a thorough annealing of the complete part after the welding has been performed.

The importance of annealing as a part of reclamation is such that unless made a part of the process such repairs are not to be recommended. Although the investment in the proper facilities for annealing will in most cases be equal to the investment of the welding equipment, this same annealing facility will serve to give like treatment to other similar parts used on both freight cars and locomotives. Examples are: Cross-heads, guides, piston rods, main and connecting rods, crank pins, and many other such parts which are built up by weld-


OUTER EDGE OF BEVEL TO BE SLIGHTLY ROUNDED.
75°
SPACE SLIGHTLY OVER DIA. ELECTRODE
THESE SURFACES TO BE SAND BLASTED PREPARATORY TO WELDING.
FINISH WELD WITH WELT WHEN POSSIBLE
S NOT LESS THAN 1½ T
R 3/8" LESS T
L NOT LESS THAN ¼"
TOP SIDE
COPPER STRIP
NOTE:-
MOST ALL FRACTURES IN FACE OF COUPLERS ARE AT TOP SECTION. FRACTURE NO 1
ALL WELDS EXCEPT POSSIBLY NO 3 CAN BE FINISHED WITH A SLIGHT WELT.
WHEN COUPLER IS SPRUNG AT FRACTURE NO 1 OR 2, IT SHOULD BE HEATED AND PRESSED INTO PLACE - TO GAUGE.
WHEN WELDING FRACTURES NO 1 OR 2, IT IS ADVISABLE TO PLACE A COPPER STRIP OR ROD, ON REVERSE SIDE OF 'V' (D) TO SERVE AS A BACKING FOR FUSED-IN METAL AND TO ELIMINATE POSSIBLE PROJECTIONS WHICH MAY INTERFERE WITH OPERATION OF COUPLER LOCK.

Reclaiming Couplers.

ing and should all be annealed before returning to service. In fact, many of these parts are annealed to advantage, even when welding has not been involved in order to prolong the life and prevent failure in service from fatigue. It may seem that undue stress has been directed to the question of annealing, but this is thought to be a question that has been given too little consideration if the maximum benefits and the proper extension of welding is to be made in railway shops.

A number of papers have already been read and printed in the Society Journal, drawing attention to the structural changes in parts resulting from welding. These incidental effects should not be allowed to hinder the progress of welding, and for most cases the effect can be eliminated by the simple process of annealing. Assuming no bad effects from welding, when it is considered that by virtue of building up or making repairs of parts that the service is extended to such parts, in itself gives reasons for the necessity of restoring

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TORCHWELD Welding and Cutting Equipment is continually establishing new standards for Low Up-Keep Cost.

Only a day or so ago a large steel mill in Ohio sent in a Torchweld Welding Torch which had been in uninterrupted service in their plant for nearly six years. Altho the torch handle was worn so smooth and thin that it yielded to the slightest pressure of the thumb, the torch functioned perfectly and was again put into service after the handle shell had been replaced at a nominal cost.

This record is being equalled every day by thousands of Torchweld Torches everywhere. It is only the most recent report that has come to our attention. It is not exceptional in any way, but it does explain why the many satisfied users of Torchweld Equipment not only buy repeat orders of new equipment for themselves but also recommend TORCHWELD to their friends.

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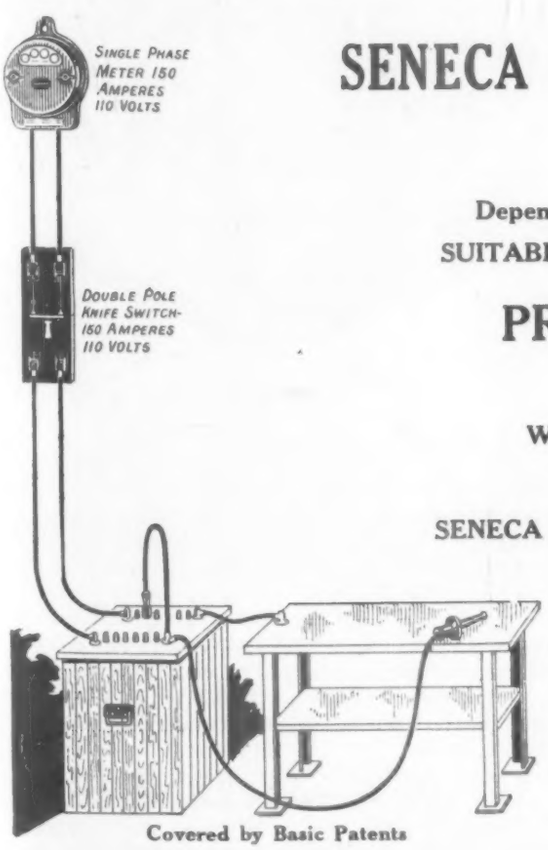

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Dependable Economical Efficient

SUITABLE FOR JOB SHOP AND PRODUCTION

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the normal structure which may have been impaired by previous service.

No detail of preparation of procedure in the actual execution of the welding has been outlined, as the methods generally used are suitable. The reference in the beginning to Interchange Rules refers particularly to Section 2, which reads as follows: "Welding practice of fractures will not be permitted on the following: Among other parts are included coupler bodies and knuckles." In reclaiming, as above outlined, it is thought these two items could and should be removed from the list of parts on which welding is not permitted. Another restriction is that of Section 4, under the heading: "Welding cracks or fractures will be permitted on the following." Among other parts, cast steel truck sides and cast steel bolsters are included, with the restriction that welding is permitted only when the area of the crack is less than two-fifths, or 40 per cent of the total area, through the section at the point of fracture, but it is not permissible to weld a crack located within 6 inches of an old weld. With a method as outlined above it is not felt that this restriction is justified, for the reason that if a reinforcing plate equal to 50 per cent of the original area is applied, that this should be the equivalent of the 40 per cent requirement above mentioned.

No special reference has been made to the question of reclamation of coupler knuckles. For this purpose the following should suffice: Coupler knuckles condemned for wear or minor fractures should be restored by welding when the cost of work required for reclamation will allow a saving over the cost of a new knuckle. Consideration should also be given to the fact that in many cases a reclaimed knuckle will give only from 50 to 75 per cent as much life as a new one, this being due to ear occurring in locations such as a knuckle pin hole, which cannot easily be corrected by welding.

In order that the maximum economy may be realized in this class of work, equipment of ample capacity must be provided. The use of high arc current is facilitated by the heavy section and by use of proper welding material. From ¼ inch to ⅜-inch electrodes can be utilized in metallic arc welding, with corresponding increased speed of welding. If such equipment is provided, the applications of reinforcing plates, as shown for truck sides, can be made, for example, in about the same length of time as would ordinarily be required to weld only the fracture with a ⅛-inch electrode.

Special attention has been called to this class of work, as it is not felt the same consideration has been given to it as is the case with locomotive parts and repairs, and as a result a vast field for welding application has been neglected, equal almost in importance to that of the locomotive shop.

This will be appreciated when it is considered that there are, roughly speaking, about twenty-five freight cars to one locomotive.

"IGNORANCE IS BLISS"

By B. Heyman

The practical oxy-acetylene operator does not usually resort to proverbs to emphasize his story, neither does he sum up his conclusions in a moral. Yet, in dealing with the situation with which one large scrap-yard has had to contend over a protracted period, it is hardly possible to ignore an axiom which so aptly applies.

This condition has to do with the theft of oxygen cylinder valves. It hardly seems possible! Yet, the writer personally noted three tanks which had been mutilated in this fashion, and a fourth so badly injured that the valve is absolutely worthless. This same thing has occurred a number of times during the past few years at this particular scrap-yard.

On construction work and in places where there is no fenced enclosure and no watchman, such an occurrence is difficult to prevent. It is hardly possible for the operator to bring in all his tanks and look them up when work is in progress. The screwed cap does not afford any protection, as its removal is very simple.

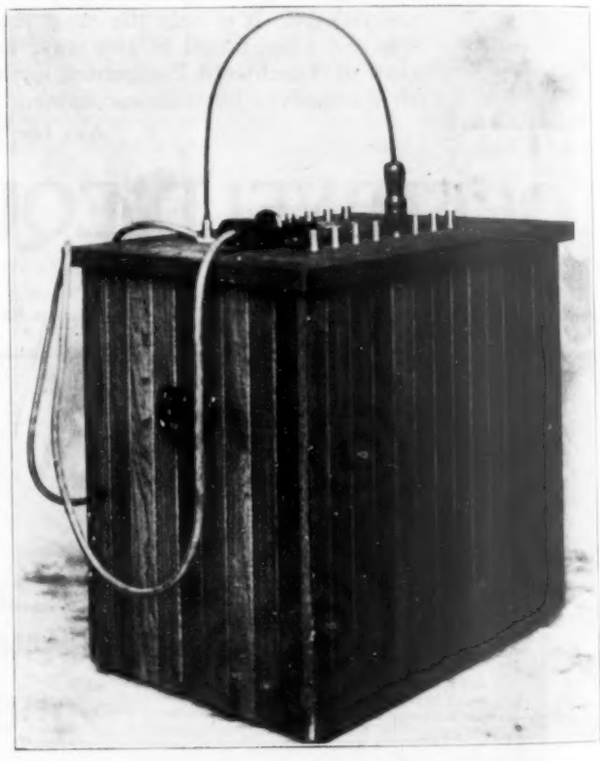
Whether the act was that of a youngster or an adult would be hard to state. Whoever did it, did it for the sake of the few paltry pennies the small quantity of brass would bring. And for the sake of this trifling sum some individual jeopardized his life. How he escaped injury can hardly be conjectured. The next time he may not be so fortunate.

Vandalism of this sort is expensive, but the actual cost in dollars and cents of the gas and material wasted is inappreciable when compared to the possible loss of life or limb of the guilty person.

SENECA ELECTRIC ARC WELDER

The Seneca Electric Arc Welder Company, of Seneca, Kansas, are manufacturing a reactance type electric arc welder, which has for the past two years been giving splendid satisfaction throughout the central and western states. This machine is known as the Seneca Electric Arc Welder. It is an alternating current type machine, available for use on 110 volt, A C power, and has a range from 30 to 180 amperes.

The heat can be changed quickly for different thicknesses of work by placing the socket connection on any one of the plugs. A carbon electrode may be used to advantage if desired.



Seneca Arc Welder.

The manufacturers emphasize the ease of operation and splendid penetration of this equipment. The Seneca machine is manufactured under the Arendt Patents on which the Seneca Company hold an exclusive license within the territory in which they operate.

The Seneca Company has done a great deal of educational work throughout the central and western states, introducing electric arc welding into the garage, repair shop and many industries throughout that section. They have at this time a large number of machines in successful operation doing repair and production work.

NEW PORTABLE ARC WELDER

A new portable arc welder, embodying distinctive features of economy, simplicity, adaptability and dependability, is now on the market. This unit is said by the manufacturer to be de-

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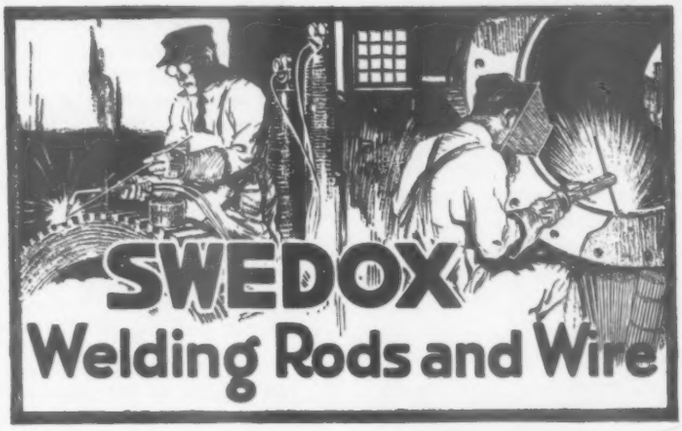

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SWEDOX welding wires and rods can be supplied immediately from stock, conforming in all respects to:

American Welding Society Specifications E No. 1-A; E No. 1-B; E No. 1-C; G No. 1-A; Folios No. 1-E and No. 1-G; and many others. We can furnish a welding wire or rod for any purpose and of any analysis required.

PUT YOUR WELDING TROUBLES UP TO US Let us prescribe the filler best adapted for your requirements. We maintain a research department conducted by experts for the benefit of our customers. This service is FREE OF CHARGE.

FLUXES—CASTOX, BRONZOX and ALUMINOX FLUXES when used with the corresponding non-ferrous filler rod will keep impurities out of the weld and promote thorough fusion.

FREE trial samples of any product will be furnished upon request. A trial of any SWEDOX product will convince you of its superiority. Send for these samples NOW

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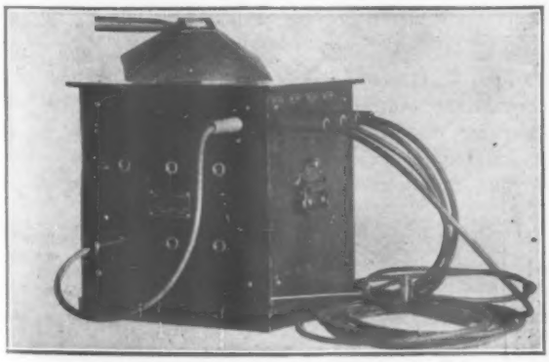
110 Volt **METWELD** 220 Volt

An A. C. Arc Welder that gives results. Portable weighs 195 lbs.



Gives machinable welds.
Welds Cast Iron and Steel. Price $400.00
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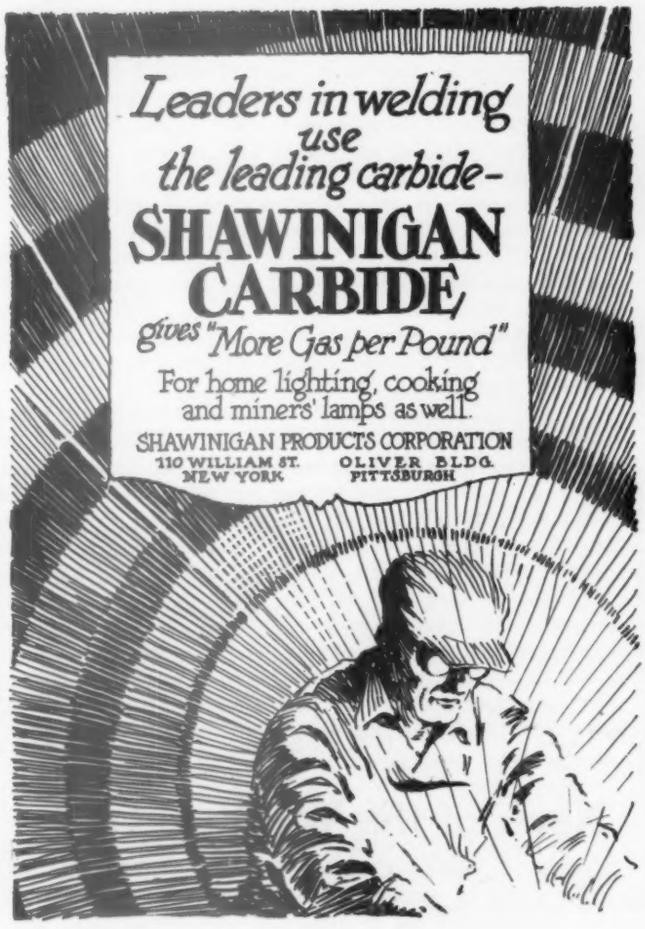
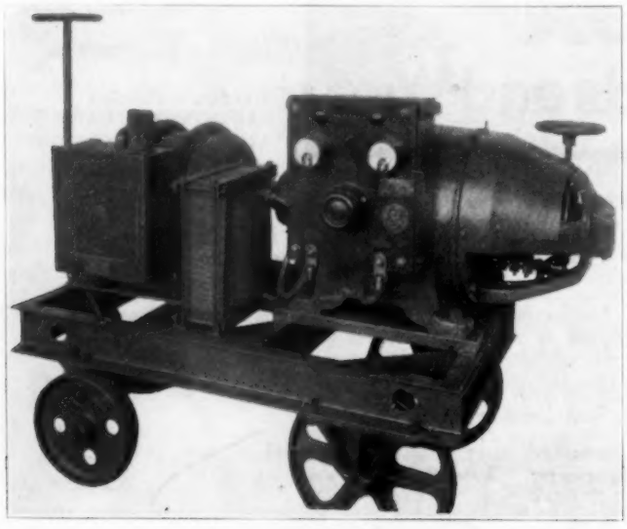


signed to insure smooth and rapid deposition of metal with thorough penetration. It will deliver continuous power and permit rapid production, both with high current and large electrodes, as well as with low current and small electrodes.

This welder is a two-unit set, consisting of a motor and a generator. The generator is self-excited, thereby eliminating the necessity of a separate exciter. All regulation of current is accomplished by turning a handwheel on the generator. A self-adjusting, stabilizing reactor is provided, which automatically steadies the arc under all welding conditions.



New G. E. Portable Arc Welder.

The new welder is made by the General Electric Company. It can be used with any of the commercial sizes of metallic electrodes from 1/8" to 1/4" in diameter. Generator voltage can be adjusted to suit the character of the work. High voltage for complete penetration on heavy work and low voltage to prevent burning through on light work are thus secured at will. Any value of current between 75 and 300 amperes can be obtained in a larger number of steps between these limits.

Among the operating advantages of this outfit are: an arc easy to start and maintain, roller bearing wheels, holes in base for crane hooks and adaptability to long or short leads, for working close by or at a distance from the set.

Among the mechanical advantages are included motor and generator insulation designed to withstand severe operating conditions both with regard to duty cycle of the load imposed and general atmospheric conditions under which ordinary insulation fails. Bearings are waste-packed and oil cannot be spilled if the set is tipped when being moved.

This WD-12 generator is a two-pole, self-excited, constant energy, single-operator machine with a dual magnetic circuit designed to operate at 60 volts open circuit and 20 to 25 volts under load. It is rated 200 amperes for continuous service, 250 amperes for one hour and 300 amperes for short periods. The motor is a standard General Electric 10 horsepower unit. The complete set has three bearings, the two units being close-coupled by a solid flange coupling. All parts, including generator, motor, generator control panel, motor starter and stabilizing reactor, are mounted on a welded structural steel base of rigid construction and light weight.

The assembled unit is about 63 inches long, 29 inches wide and 47 inches high, weighing about 1,600 pounds.

News of the Welding Trade

The Gibb Instrument Company, of Bay City, Michigan, will have an exhibit of welding apparatus at the Automotive Maintenance Equipment Show in connection with the National Automotive Service Convention to be held in the General Motors Building, Detroit, May 19th to 23rd.

The Weldit Acetylene Company, Detroit, Michigan, recently moved to new quarters at 638 Bagley Avenue, where they will have greatly enlarged facilities.

Mr. Henry Booth, of Shawinigan Products Corporation, spent a couple of days in Chicago last month on a business trip.

H. S. Tarbert has joined the sales force of the International Oxygen Company, at Pittsburgh, Pa. Mr. Terbert was formerly connected with the MacBeth-Evans Glass Company, Pittsburgh.

Mr. Newton D. Schulman is Sales Agent for the International Oxygen Company, at Toledo, Ohio.

It is reported that the Tulsa Oxy-Hydro Company, of Tulsa, Oklahoma, manufacturers of oxygen and acetylene apparatus, is planning to build a branch plant at Springfield, Mo.

Electric welding machines and parts will be manufactured by the Ness Electric Welding Machine Company, 48 Howard Street, New York City, which was recently incorporated with a capital stock of $100,000.

The Superior Welding & Machinery Company, of Atlanta, Ga., will shortly occupy new and larger quarters at 709 Marietta St.

A one-story plant 40x100 ft. is being constructed at North Turner Street and Howard Avenue, Lansing, Michigan, by the Central Welding Company, who specializes in oxy-acetylene welding.

At a recent meeting of the Brooklyn Engineers Club, Mr. Johannes Kjekstad, of the S. O. S. Welding Corporation, Brooklyn, N. Y., read a paper on the subject of "Modern Welding Practice."

The Wilson Welder & Metals Company, formerly located at 132 King Street, New York, moved to their new plant and general offices in the Wilson Building, Hoboken Factory Terminal, Hoboken, N. J., on May 1st, and report that the increased demand for welding machines and welding wires has necessitated an increase in their manufacturing facilities.

Mr. Fred C. Heppel, who is well known to the oxy-acetylene industry in the central west, is back on his old job as Sales Manager for the Tulsa Oxy-Hydro Company after an absence of several months in the electrical business, which he says has taught him that there is no game so good as the welding game.

E. R. Lindsey, who has charge of the service department of the Canadian Liquid Air Co., Ltd., Montreal, Canada, spent a couple of days in Chicago recently while on his way to the Pacific Coast where he is planning to take a month's vacation.

The Ox-Hydrogen Manufacturing Company, Kansas City, Missouri, was recently elected an active member of the Gas Products Association.

Word has been received of a proposed oxygen plant to be constructed at Harrisburg, Pa., by the Air Reduction Sales Company, and estimated to cost $75,000.

Among the welcome visitors to Chicago during the past month was Mr. M. M. Smith, the genial manager of the Commercial Supply Company, New York City.

COFFIN HONORED BY FRANKLIN INSTITUTE

Charles A. Coffin, former president of the General Electric Company, was awarded a certificate of honorary membership in the Franklin Institute on April 16th at Philadelphia. This honor, conferred by one of the foremost scientific societies in the world, was in recognition of Mr. Coffin's many achievements and contributions to the electrical industry.

The presentation was made in the assembly hall of the Institute in Philadelphia. Included in the audience were leading figures in Philadelphia's scientific life, men who are carrying on the tradition which is the outgrowth of the policy Benjamin Franklin laid down when he founded the Institute in 1824.

In introducing Mr. Coffin, Samuel Insull, president of the Commonwealth Edison Company of Chicago, said:

MECHANICAL ENGINEERS HANDBOOK

The McGraw-Hill Publishing Company, of New York, have just published the Second Edition of the Mechanical Engineers Handbook edited by Prof. L. S. Marks.

This book contains nearly two thousand pages of engineering information and data carefully arranged in fifteen sections and provided with a good index. The arrangement of the subject matter is as follows:

Mathematical Tables, Weights and Measures, Mathematics, Mechanics of Solids and Liquids, Heat, Strength of Materials, Materials of Engineering, Machine Elements, Power Generation, Hoisting and Conveying, Transportation, Building Construction and Equipment, Machine Shop Practice, Pumps and Compressers, Electrical Engineering and Engineering Measurements.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of The Welding Engineer, published monthly at Chicago Post Office, Chicago, Ill., for April, 1924.

STATE OF ILLINOIS,
COUNTY OF COOK, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared H. S. Card, who, having been duly sworn according to law, deposes and says that he is the business manager of the The Welding Engineer and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, L. B. Mackenzie, 7131 Crandon Ave., Chicago, Ill.
Editor, L. B. Mackenzie, 7131 Crandon Ave., Chicago, Ill.
Managing Editor, L. B. Mackenzie, 7131 Crandon Ave., Chicago, Ill.

Business Manager, H. S. Card, 7201 Constance Ave., Chicago, Ill.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.)

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ..... (This information is required from daily publications only.)

H. S. CARD,
(Signature of business manager).

Sworn to and subscribed before me this 31st day of March, 1924.
WILLIAM DUZBACH,
Notary Public.
(SEAL.)
My commission expires April 7th, 1925.

WELDING TAUGHT IN KANSAS CITY TRADE SCHOOL

Oxy-Acetylene Welding is one of the subjects which is being given careful attention in the Lathrop Trade School, of Lansing City, Mo. The Welding Department is in charge of Mr. John McLeod, who came to this country many years ago, and is said to have established the first welding shop in Kansas City. The Printing Department of this School gets out a very interesting weekly paper, which recently featured an article on "Oxy-Acetylene Welding," by Mr. McLeod. Unfortunately space limitation prevents the reproduction of this article, which calls attention to a number of interesting historical facts concerning the process, and points out some of the important applications.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address

For Sale—Boiler and welding Business. Oklahoma is largest Oil field. Good all the time. Bad health and other business, reason for selling. Will invoice $8,000.00. Oxygen Acetlyene and Electric, $4,000.00 cash, balance on notes, or will sell any part of it, come and see for yourself. Drumright, Oklahoma, Box 951.

I WANT "SELLERS"

Men who hate alibis and excuses, who go to work at 8:30 a. m., who work like hell all day, follow directions, and get orders, can make money selling REGO welding and cutting equipment which has proven itself to be THE equipment of the day for the large and small shop.

Plenty of sales helps for hard WORKERS, but no drawing accounts. Strictly commission. Should make $100 weekly; harder to earn $150; but you can earn $10,000 yearly and more, if you study hard, get down early, follow your leads, Work hard and SELL.

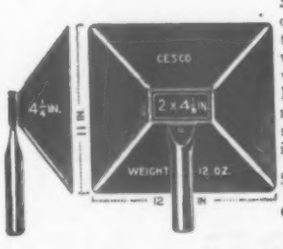
Write for interview. Don't fear a crowd, as I expect few replies; most alibi shooters dodge such ads. They can't pay the price of success—eternal study and WORK. THE BASTIAN-BLESSING COMPANY, 240 E. Ontario Street, Chicago, Illinois.

Manager Wanted to take charge of Chicago office of manufacturer of Electric Welding Equipment.

Should have
1. **Intimate knowledge of Electric Welding both Arc and Resistance.**
2. **Experience in sale of Electric Welding machines, preferably but not essentially in the Chicago District.**

Please cover these points fully in your first letter.
XYZ c/o THE WELDING ENGINEER.

CESCO HAND SHIELD



Style No. 10—Made of Black Vulcanized fibre formed as cut shows to eliminate all light rays. Fitted with our **Essentialite Welding Glass,** which is scientifically correct. Lenses are easily changed by the new device. The jobbers that have seen **Cesco Hand Shield** pronounce it the best made.

Send for a sample and be convinced.

Cesco Hand Shield No. 10 sells for $3.00 each.

Manufactured by

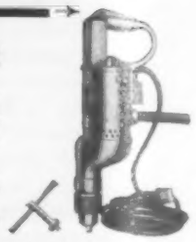
CHICAGO EYE SHIELD CO.

2304 Warren Avenue Chicago, Ill.

The "WODACK Welders' Special" Cuts Grinding Cost

If you operate an electric welding machine you don't have to install expensive air compressing machinery for your grinding and drilling operations. WODACK Portable Electric Grinders and Drills can be furnished with special windings to operate directly from your welding machine. Write for details about the Welders' Special and we will tell you how to give your customers better work at a reduced cost.

WODACK ELECTRIC TOOL CORPORATION, 43 S. Jefferson St., Chicago, Ill.



CURRENT WELDING LITERATURE

THE EFFECT OF OXY-ACETYLENE CUTTING ON STEEL—The results of a number of experiments to determine the action of the oxy-acetylene cutting flame upon steel in the neighborhood of the cutting illustrated by microphotographs. The effects are shown to depend upon the skill of the operator; the conclusion being that the effect of the cut on the strength of ordinary mild steel is quite negligible.—Industrial Gases, London, March.

CAST IRON CUTTING BY OXY-ACETYLENE PROCESS IN LONDON—Some particulars regarding cast iron cutting operations recently performed by a London firm. The Oxy-Acetylene Cutting Torch was shown to be very efficient compared to the ordinary drilling methods which had previously been used.—Industrial Gases, London, March.

TANKS FOR AEROPLANES FABRICATED FROM SHEET ALUMINUM BY WELDING—The impossibility of obtaining a lasting, leaf proof riveted joint has lead to the adoption of oxy-acetylene welding for these aeroplane tanks. Welding is also used in the construction of radiators for some types of planes. Industrial Gases, London, March.

HUGH ALUMINUM STILL OXY-ACETYLENE WELDED—A description of the methods followed in constructing very large stills recently built of ¾ in. thick aluminum plate.—Industrial Gases, London, March.

SCRAPPING BATTLESHIPS IN U. S. A., by G. O. Carter—Some interesting particulars regarding the use of the cutting torch in the demolition of battleships at the Brooklyn Navy Yard.—Industrial Gases, London, March.

WELDING AND CUTTING APPLICATIONS—The possibilities of welding as a fabricating process—The possibilities of welding in the repair field—The use of the electric arc for welding and cutting—The use of the oxy-acetylene torch for both welding and cutting—Cutting in railroad shops and scrap yards—The field of thermit welding—Railroad and railway field.—Railway Purchases and Stores, May.

DESIGNS OF WELDS—FLEXIBILITY VERSUS RIGIDITY—A discussioin of the question of proper design for welded joints. For Carbon Arc Welding the discussion is furnished by J. C. Lincoln, for Gas Welding by S. W. Miller, for Metal Arc Welding by C. J. Holslag, for Resistance Welding by H. A. Woofter, for Thermit Welding by J. H. Deppeler.—Journal of the A. W. S., April.

RECLAMATION OF CAST STEEL CAR CASTINGS BY ARC WELDING, by H. R. Pennington. Outline of practices for the reclamation of steel castings which have been in use for several years with no greater percentage of failures than that of new and unwelded similar parts. The design of joints and the methods of completing the welds are illustrated by line drawings, and careful attention is given to the importance of annealing after the welding has been finished.—Journal of the A. W. S., April.

FLUXES AND SLAGS IN WELDING, by W. Spraragen—A digest of the opinions of several writers on the subject of "Fluxes and their Uses," in the various welding processes.—Journal of the A. W. S., April.

WELDING MANIFOLDS, EXHAUST TUBES AND TRUNKS, by Z. T. Davis—How a manufacturer who specializes in metal stampings and fabricated units for the automotive industry, uses the welding process to make sure of getting joints which will be permanently tight and strong.—Journal of the A. W. S., April.

OXY-ACETYLENE TIPS—Monthly publication of the Linde Air Products Company. The May issue contains the following articles. Cutting operations in a Maintenance of Way Department—Handling a troublesome job—Welded spouts for gasoline tanks—Reducing idle time in the job shop—Keeping waste down and production up—Welding assures smooth production—New parts from old—Shop welds a variety of light sheet metal products—Sixteen ton casting quickly repaired—Cheap fuel may not give economical heat—Making machine alterations practicable.

FLEXIBILITY VERSUS RIGIDITY IN THE DESIGN OF WELDS—Abstract of papers presented before the annual meeting of the American Welding Society as mentioned above.—Railway Electrical Engineer, May, and The Iron Age, May 8th.

STEEL AND ITS PROPERTIES IN RELATION TO WELDING, by Prof. F. C. Thompson—In studying the properties of welded material, it has been shown that determinations of tensile strength alone are almost worthless. It appears that steel in which a crystal would grow the quickest will weld the most easy. Important variations in the strength of steel caused by varying the chemical content are pointed out.—Acetylene and Welding Journal, London, April.

RESISTANCE WELDING, by Mrs. Zeila McBerty—The advantages of resistance welding, and discussions of Butt Welding, Spot Welding and Seam Welding.—Acetylene and Welding Journal, London, April.

OXYGEN BY THE LIQUEFACTION PROCESS, by Alan G. Wikoff—A description of the Air Liquefaction Oxygen Producing Process illustrated by diagrams of the apparatus used. The simplicity of operation and the necessity for using a very efficient air compressor are emphasized.—Chemical and Metallurgical Engineering, February.

SMITH'S WELDING AND CUTTING EQUIPMENT—Twenty-four page folder describing and illustrating welding and cutting outfits—Torch and regulator units—Acetylene generators—Fluxes and supplies for the welding shop recently issued by Smith's Inventions, Inc., Minneapolis.

A NEW FIELD FOR THE OXY-ACETYLENE PROCESS—How the bronze weld is replacing the cast iron weld in long cast iron pipe lines. The joint is made by applying what is practically a bronze band around the joint; the saving in gas and time serving to offset the greater cost of bronze welding rod over the cast iron rod.—Acetylene Journal, May.

SOME CHEMICAL ASPECTS OF WELDING, by J. R. Booer—Slag formation during the welding operation results in the removal of the by-products of reduction and the oxide of the metal which is being welded. Instructions are given for the use of fluxes in welding different metals.—Acetylene Journal, May.

CUTTING A TWENTY-SEVEN INCH SHAFT WITH OXY-HYDROGEN—Procedure and apparatus used in making a series of cuts through a solid steel generator shaft. The fact that no power was available at the place where the work was done may be necessary to adopt some very ingenious devices to carry through this work.—Acetylene Journal, May.

COMPRESSED-DISSOLVED ACETYLENE, by M. A. Dantzler—How acetylene is manufactured and procedure followed in storing it in tanks for shaping. Some of the problems which confront the manufacture of dissolved acetylene.—Acetylene Journal, May.

FUSION WELDING OF PRESSURE VESSELS AND PIPE LINES, by S. W. Miller—A discussion of the designs of joints in pressure welding, pointing out how a faulty design may result in failure which might easily be avoided.—Acetylene Journal, May.

ELECTRIC ARC PROCESS FOR SCRAPPING STEEL CARS, by A. M. Candy—Steel cars are quickly reduced to scrap by cutting through the plates and angles and knocking apart with a large skull cracker. To use the process at its best efficiency, it is necessary to plan the electrical installation carefully and provide facilities for these operations.—Railway Electrical Engineer, April.

SUMMER SCHOOL AT CARNEGIE TECH

A large majority of the regular faculty staff at Carnegie Institute of Technology in Pittsburgh, says an announcement, will conduct the work of the Summer School which opens June 16 and ends August 8, and which will include a variety of engineering courses. For some of the Departments specializing in teacher's courses, however, several guest instructors and lecturers have been engaged to assist at various periods between June 30 and August 8 when the courses for teachers of Home Economics, Public School Music, Fine and Applied Arts, and Manual and Industrial Arts are scheduled.

According to the report from Carnegie Tech, plans are underway to receive a record-breaking enrollment of summer students this year. The increasing popularity of the technical courses not only for teachers, but for undergraduates and others needing practical training, together with the unusual facilities available at Carnegie for such instruction, are cited as reasons for the increase in inquiries from prospective students.

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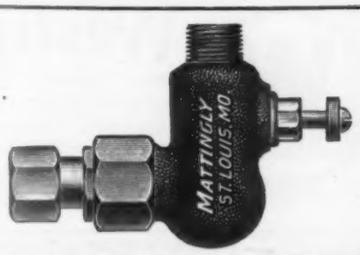

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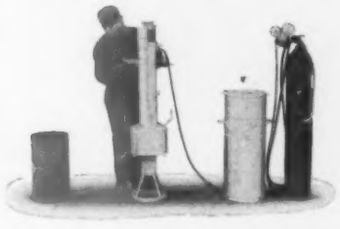

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